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Measurement Bias in the Canadian Consumer Price Index: An Update

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- The consumer price index (CPI) is the most commonly used measure to track changes in the overall level of prices. Although the CPI has some advantages—it is timely and it focuses on transaction prices—it is not a true cost-of-living index and is therefore subject to measurement bias.
- This article describes the four main sources of bias in the CPI and provides estimates of their size, both in absolute terms and relative to those obtained in previous studies conducted at the Bank of Canada.
- The total CPI measurement bias is estimated to be about 0.5 percentage point per year over the 2005–11 period, consistent with the Bank's earlier findings. Slightly more than half of this bias is caused by the fixed nature of the CPI basket of goods and services. More frequent updates of the weights that are used in the basket would reduce this error by more accurately reflecting changes in spending patterns following a change in relative prices and the introduction of new products.

The consumer price index (CPI) tracks changes in the overall level of the prices of consumer goods and services (i.e., inflation) by computing the cost of buying a fixed basket of goods and services over time.[1] This basket represents expenditures made by a representative household during a specific period and is updated periodically to reflect shifts in the spending patterns of Canadian consumers.[2]

The CPI serves two main purposes. First, it is widely used by consumers, corporations and government agencies to measure changes in purchasing power over time and to index expenditures and incomes. Second, it plays a central role in the Bank of Canada's monetary policy framework, particularly since the adoption of the inflation-targeting regime in 1991, which established the Bank's official inflation target as a 2 per cent rate of inflation

1 Other measures of inflation exist. For example, the implicit price deflator of gross domestic product is a production-based measure that covers the entire economy.

2 The CPI assigns weights to the various items in the index. To maintain a basket that is broadly representative of current consumption patterns, Statistics Canada revises the weights for individual items approximately every four years using information from its Survey of Household Spending. The most recent weight update was introduced with the release of the May 2011 CPI and was based on the 2009 survey.

as measured by the CPI. The CPI is used extensively for these purposes because it is available on a monthly basis, it has a short publication lag, and it relies heavily on retail transaction prices rather than imputed prices.[3, 4]

The CPI is not a cost-of-living index (COLI), since, for example, it does not adjust quickly to changing consumption patterns. The CPI measures changes in the cost of a fixed basket of goods and services over time, while a COLI measures the changes in the minimum cost to attain a fixed standard of living. Thus, since the CPI departs from a true COLI, it is subject to measurement bias and does not necessarily reflect real changes in the well-being of consumers, which could be problematic for monetary policy and when making cost-of-living adjustments to wages and salaries. For monetary policy, since this bias may vary over time and there is no systematic way to forecast it, difficulty could arise when assessing whether an increase in the measured rate of inflation is the result of a true change in prices or an increase in measurement error. In addition, errors in the measured rate of inflation could lead to important income redistribution effects among economic agents and possible distortions in the government's fiscal system (Ragan 2011).[5]

Biases in the measurement of CPI can occur for four main reasons: (i) the CPI methodology does not capture the ability of consumers to substitute away from more expensive goods in response to changes in relative prices (commodity-substitution bias); (ii) it does not capture the cost savings from shifting to lower-priced retail outlets (outlet-substitution bias); (iii) new products or brands may be excluded from the current basket, and welfare gains from a broader selection of goods and brands will not be captured (new-goods bias); and (iv) quality changes may not always be properly captured by statistical agencies (quality-adjustment bias). The following sections elaborate on these types of bias.

Commodity-Substitution Bias

Commodity-substitution bias reflects the fact that, while the weights of items in the CPI basket are held constant for a period of time, a change in relative prices may cause patterns in consumer spending to change. If, for example, the price of chicken were to increase considerably following supply constraints, consumers would likely purchase less chicken and increase their consumption of beef, since the two meats may be perceived as substitutes for each other. The CPI, however, assumes that consumers would continue to purchase the same quantity of chicken following a price change. This means that the measured change in the CPI will overstate the increase in the minimum cost of reaching a given standard of living (i.e., there is a positive bias).

Commodity-substitution bias reflects the fact that, while the weights of items in the CPI basket are held constant for a period of time, a change in relative prices may cause patterns in consumer spending to change

3 For a more comprehensive discussion of the advantages of using the CPI, see Crawford, Fillion and Laflèche (1998).

4 Imputed prices are not directly observable, but can be inferred using data on average production costs or the prices of similar products. Imputed prices are used more frequently in a personal consumption expenditure (PCE) deflator than in the CPI. For example, the deflator uses implicit prices to measure the cost of owner-occupied housing (employing the approach of rental equivalence) and health care services.

5 In particular, with a positive CPI bias, fiscal revenues would be lower, since the basic personal exemption would be too high relative to what it would be if based on the change in the cost of living, while government expenditures would be higher, since many transfers such as childcare benefits are indexed to the measured rate of inflation.

The size of commodity-substitution bias can be determined by comparing the official CPI series with a measure of the cost of living. Using a retrospective Fisher index for the COLI,[6] we estimate that the size of the commodity-substitution bias in Canada is 0.20 percentage point,[7] on average, per year over the 2005–09 period.[8] This result is similar to the bias of 0.23 percentage point per year obtained for the 2005–11 period, using the approach of Diewert (1998).[9] These findings (an average of about 0.22 percentage point per year) are somewhat higher than the 0.15 percentage point per year reported in a previous Bank study (Rossiter 2005) for the 1998–2004 period. The difference in our estimation relative to previous studies is mainly the result of variation in the amounts of relative price changes over the sample periods.

Outlet-Substitution Bias

Prices for most items in the Canadian CPI are collected from a sample of retail outlets that have high-volume sales of each commodity. However, if the outlet sample is fixed, a potential bias could occur when prices for goods and services of identical quality are consistently cheaper in certain types of outlets, causing consumers to shift their patronage from one type of retail outlet to another (for example, from higher-priced traditional stores to lower-priced big-box retailers). A fixed outlet sample would not capture the decrease in average price arising from the continuous growth in market share of discount stores in some segments of the Canadian retail market, resulting in a positive outlet-substitution bias.[10]

If the outlet sample is fixed, a potential bias could occur when prices for goods and services of identical quality are consistently cheaper in certain types of outlets, causing consumers to shift their patronage from one type of retail outlet to another

Three pieces of information are required to calculate this outlet-substitution bias: (i) the components of the CPI basket that are likely to be affected, (ii) the change in market share of discount retailers for these items, and (iii) the percentage difference in quality-adjusted prices between discount retailers and traditional retailers.[11]

To determine the overall impact of outlet-substitution bias on the CPI, the components subject to this bias are assumed to include most items sold by retailers (excluding such goods as gasoline and automobiles),[12] representing about 35 per cent of the CPI basket.[13] Access to data on the market shares

6 The retrospective Fisher index is defined as the geometric average of the Laspeyres and Paasche indexes. The Laspeyres index is based on prior-period weights and tends to overstate increases in the cost of living, while the Paasche index is calculated with current-period weights and tends to understate increases in the cost of living. The Fisher index is calculated retrospectively once information on current-period weights becomes available. For more details on these indexes, see ILO (2004).

7 While many of the statistics reported are in two-decimal-point form, our estimates do not have that level of precision. We use two decimal points to reduce rounding errors when components are added.

8 The result covers the 2005–09 period, since the Paasche index was based on the latest Survey of Household Spending and could be calculated only up to 2009.

9 Diewert (1998) shows that the bias can be approximated using a formula that depends only on the dispersion of relative prices.

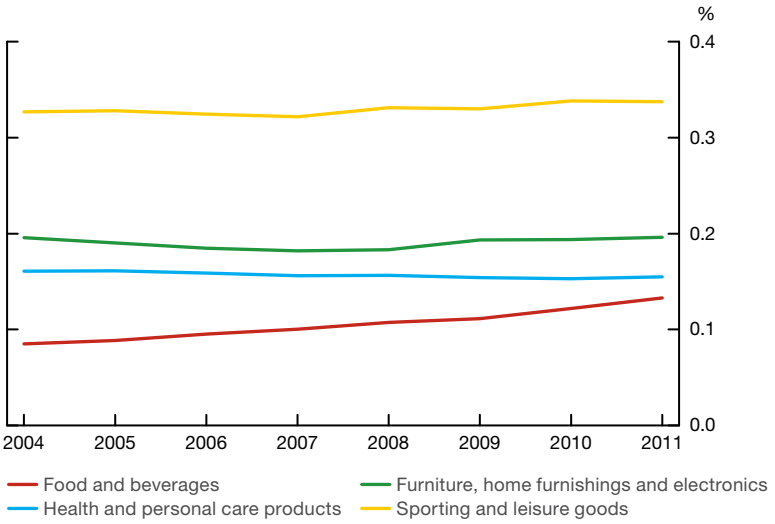
10 When rotating outlet samples, Statistics Canada assumes that quality-adjusted prices are identical at the old and new outlets (i.e., the observed price differential is fully explained by an equivalent difference in quality between the two outlets), thus outlet rotations do not lead to a decrease in the measured price. If this assumption were incorrect, outlet-substitution bias would remain, even with more-frequent outlet rotations.

11 Estimates of the size of outlet-substitution bias must take into account the fact that the market price of an item depends on both the quality of the commodity and the quality of the retail outlet where it is purchased, based on such factors as the level of service and the convenience of the location.

12 Items subject to outlet-substitution bias include food purchased from stores; clothing and footwear; communications products and services; household chemical products; paper, plastic and foil supplies; household furnishings; air transportation; health care goods; personal care supplies and equipment; recreational equipment and services; home entertainment equipment and services; tobacco products; and books.

13 Outlet-substitution bias does not exist for those items provided by a single supplier in a given market or where there may be many outlets, but no significant changes in market share. Most of the services in the CPI are also judged not to be subject to outlet-substitution bias.

Chart 1: Market share of general merchandise stores



Sources: Statistics Canada and Bank of Canada calculations Last observation: 2011

of discount stores for all categories of items would be ideal; however, these data are available only for clothing and footwear (through Trendex).[14] Trendex indicates that the market share of discount stores for clothing and footwear increased by 0.7 per cent per year between 2004 and 2008. For other goods, market shares of general merchandise stores are used as a proxy for the market shares of discount retailers. These data are from Statistics Canada's Quarterly Retail Commodity Survey (QRCS)[15] or from Rossiter (2005). **Chart 1** shows the evolution since 2005 of the market shares of general merchandise stores for different types of goods. According to the QRCS, among general merchandise stores, only the market share for food and beverage purchases has grown. For most other goods included in the QRCS data, the market share has remained relatively unchanged.[16]

Using microdata on the retail food industry in the United States, Greenlees and McClelland (2011) estimate that the average quality-adjusted prices[17] for food and beverages are about 10 per cent lower in discount department stores and warehouse clubs than in traditional large grocery stores. We therefore use a discount of 10 per cent for food purchased from stores included in the CPI. For other CPI components, we use the assumptions for price discounts used in Rossiter (2005)—a 15 per cent discount for clothing and footwear and 10 per cent for the remaining components—since no new evidence has become available.

These assumptions are different from the approach taken by Statistics Canada when constructing the CPI, which does not assume a divergence in the quality-adjusted prices between retail outlets. Instead, Statistics Canada

14 Trendex North America is a marketing research and consulting firm specializing in the Canadian and Mexican markets. The information used in this article is taken from its 2008 reports on the Canadian apparel market.

15 The QRCS provides a breakdown of retail sales by commodity type as well as by the type of retail outlet where the commodities are sold.

16 For the components of the CPI basket that were previously identified as subject to outlet-substitution bias, but for which no data are available from the QRCS or Trendex, we use the same market-share progression as in Rossiter (2005), i.e., 2.5 per cent per year.

17 Greenlees and McClelland (2011) use hedonic regression to account for the differences in item characteristics.

attributes any divergence in prices between two types of outlets to differences in the quality of the product or the quality of services provided by the different outlets, which might be too restrictive when goods are highly homogeneous and outlets provide the same quality of service, or when the market has not yet reached an equilibrium state (i.e., the market shares of different types of outlets are continuing to evolve).

Table 1 shows the results for outlet-substitution bias. By combining the information on the average annual change in market share and the price discount for the different CPI components, we find that outlet-substitution bias is about 0.04 percentage point per year, which is slightly weaker than the 0.08 percentage point per year assessed previously (Rossiter 2005). The lower estimation for outlet-substitution bias relative to the previous Bank study is due to the stabilization in the market shares for some goods. The upper bound is calculated using a price discount of 15 per cent for all components subject to outlet-substitution bias, and could also be consistent with a period of more-rapid changes in market shares.

Table 1: Contributions to outlet-substitution bias

CPI components	Weights (%)	Change in market share (percentage points per year)	Price discount (%)	Bias (percentage points per year)	Upper bound (percentage points per year)
Food purchased from stores	11.2	0.70	10[c]	0.01	0.02
Health and personal care products	3.3	-0.10	10[d]	0.00	0.00
Clothing and footwear	5.0	0.70[b]	15[d]	0.01	0.01
Furniture, home furnishings and electronics	4.1	0.00	10[d]	0.00	0.00
Sporting and leisure goods	1.3	0.20	10[d]	0.00	0.00
Other goods and services that could be subject to outlet-substitution bias[a]	9.4	2.50	10[d]	0.02	0.03
Total CPI (sum)	34.3			0.04	0.06
Total CPI (Rossiter 2005)				0.08	0.10

a. Communications products and services; household chemical products; paper, plastic and foil supplies; air transportation; home entertainment equipment and services; tobacco products; and books
b. Based on the database provided by Trendex
c. Based on Greenlees and McClelland (2011)
d. Based on Rossiter (2005)

New-Goods Bias

Bias may also occur if the CPI methodology does not capture the effects on the true cost of living from the introduction of new goods. For convenience, we can decompose the total new-goods bias into a bias associated with the introduction of entirely new categories of goods (new-products bias) and a bias caused by the introduction of new brands of existing products (new-brands bias).

New-products bias

While new products (such as high-definition televisions or electronic tablets) are regularly introduced into the retail market, there is a lag before they enter the CPI basket because the basket's product classification is updated only periodically. Since new goods and services are not immediately captured in the CPI, and the rate at which their prices change (adjusted for quality) is different from that of items already included in the basket, the CPI is subject

◂ *Since new goods and services are not immediately captured in the CPI, and the rate at which their prices change is different from that of items already included in the basket, the CPI is subject to new-products bias*

to new-products bias. For example, when the evolution of prices for new goods that have not yet been incorporated into the CPI basket is slower than the average evolution of prices for goods already included in the basket, the CPI is positively biased.[18] This is usually the case for many electronic products, the prices of which tend to fall immediately after their introduction to the market. In addition, failure to include new products in the CPI basket implies an underestimation of welfare gains to consumers resulting from the availability of a wider range of products.[19]

To calculate new-products bias, we need to know the percentage of new goods not yet introduced into the CPI basket, as well as the average percentage difference in the changes in the quality-adjusted prices for new goods relative to goods already included in the CPI.

In the latest basket update (May 2011), for example, new retail products that had already been available for some time were added to the basket, including telephone equipment and emerging multi-purpose digital devices such as smart phones and tablet computers. These goods, which carry a weight of 0.1 per cent of the CPI, would likely cause a positive bias, since they already appeared in the market but their introduction into the CPI basket was delayed between the 2007 and 2011 updates.

Several sources of information (including Hausman (1997) and the *Washington Post* (2011)) suggest that the relative prices of these products experienced an average decline of about 5.5 per cent per year for telephone equipment (from 1998 to 2008) and 8 per cent per year for smart phones and tablet computers (from 2005 to 2010).[20] As shown in **Table 2**, the upward bias on total CPI that is created by these new products amounts to only about 0.01 percentage point annually, given that their weight is so small.[21]

As suggested by Diewert (1998), new-goods bias extends beyond new inventions and could also refer to the wider selection of products that consumers can choose from, given advancements in telecommunication technologies (online shopping) or better transportation infrastructure (providing easier access to more stores). The increased product variety resulting from fewer geographical restrictions may lead to a positive bias, since the expanded access to a wider variety of products leads to welfare gains that are not captured in the CPI. Estimating the contribution of these factors to the bias is based on judgment. The increase in market share of e-commerce from slightly less than 1 per cent of total retail trade in 2004 to about 8 per cent in 2010[22] suggests, however, that these factors are important and have likely intensified.[23] An average bias of 0.09 percentage point per year is

◂ *New-goods bias could also refer to the wider selection of products that consumers can choose from, given advancements in telecommunication technologies or better transportation infrastructure*

18 Despite their exclusion from the CPI basket, there would be no new-products bias if the evolution of prices for new goods were the same as that of the overall index.

19 The fixed nature of the CPI basket does not necessarily mean that it fails to capture indirect effects, since the presence of these new products in the marketplace might put downward pressure on prices for obsolete items that are still included in the CPI basket.

20 These reported declines are not adjusted for quality; hence, it is likely that the real decline is larger, given the degree of technological advancement that accompanies these products. However, since their weight is low, an assumption of 10 per cent would result in the same overall impact when rounded to the second decimal point.

21 In addition, other new goods (for example, satellite radio receivers, the latest video game consoles and single-serving coffee makers) may already be in the market but not yet captured by Statistics Canada, which would likely increase the amount of this bias modestly.

22 According to Forrester Research, Inc. (Indvik 2011)

23 The rise in online sales is the result of such factors as increased Internet connectivity (with devices such as smart phones and tablets), better-performing search engines, and an intensification of online accessibility by retail firms.

assumed to result from this increased access, with a total bias of 0.10 percentage point for new products, which is in line with the estimates provided by both Rossiter (2005) and Crawford (1998).[24]

New-brands bias

New-brands bias results from potential gains in consumer welfare owing to the availability of a greater selection of brands among goods already included in the CPI basket

Another type of new-goods bias is new-brands bias, which results from potential gains in consumer welfare owing to the availability of a greater selection of brands among goods already included in the CPI basket (cereals, clothing and so on). If new brands are not a perfect substitute for existing brands, an increase in the number of brands would lower the minimum cost of reaching a given standard of living, thereby reducing the cost of living. Since the CPI does not allow for these possible effects, the introduction of new brands may lead to a positive bias.[25] It is difficult to determine the value that consumers place on having access to a larger selection of brands, but it could be argued that this bias may be considerable, since there has been a significant increase in brand selection over time.

We use the same assumption as was used in Rossiter (2005) and Crawford (1998) for the potential bias arising from wider access to new brands, i.e., 0.10 percentage point per year (with an upper bound of 0.15 percentage point per year).[26] Therefore, the estimate of the new-goods bias arising from new products and new brands amounts to 0.20 percentage point per year, in line with previous studies (**Table 2**).

Table 2: Contributions to new-goods bias

CPI components	Weights (%)	Relative price decline of these new goods (%)	Bias (percentage points per year)	Upper bound (percentage points per year)
Telephone equipment	0.10	5.8[a]	0.003	
Multi-purpose digital devices (smart phones, tablet computers)	0.04	7.5[b]	0.002	
New-products bias on total CPI			0.01[c]	0.01
Better access to new goods (from improved telecommunications technologies and transportation infrastructure)			0.09	0.10
New-brands bias on total CPI			0.10	0.15
New-goods bias (new-products bias and new-brands bias) on total CPI			0.20	0.26
Rossiter (2005)			0.20	0.30
Crawford (1998)			0.20	0.30

a. Based on Hausman (1997) and the *Washington Post* (2011)
b. Based on the *Washington Post* (2011) as well as judgment
c. The total impact from new-goods bias is rounded to the second decimal point.

24 Rossiter (2005), however, attributes 0.05 percentage point to the introduction of new products (assuming an average price decline of 10 per cent for new goods with a weight of 1 per cent) and 0.05 percentage point to better access.

25 An increase in the number of brands would, however, increase competition and possibly put downward pressure on prices for top-selling items that are included in the CPI. Such an increase in brands could therefore be partially captured in the CPI.

26 With the increase in the number of choices, the consumer can achieve the same level of utility at a lower cost. Hausman (1994) estimates the effect on consumer welfare of the introduction of a new brand of cereal, and finds that the impact of new brands on consumer welfare appears to be significant.

Quality-Adjustment Bias

A bias occurs when the size of quality adjustments to separate pure price movements from quality changes is incorrect

Since the CPI basket is fixed, its quality should, in theory, remain constant over time. In practice, however, the quality of goods and services usually changes as their characteristics evolve (e.g., when flat-screen televisions replaced cathode-ray-tube televisions). To separate pure price movements from quality changes, statistical agencies usually adjust raw data using various quality-adjustment techniques. A bias occurs when the size of these quality adjustments is incorrect. Quality-adjustment biases can be either positive or negative for different components of the CPI: the bias is positive if quality improvements are underestimated and negative if they are overestimated. The size and direction of the quality-adjustment bias for the total CPI depend on the net effect of all positive and negative biases for individual items in the basket.

Our assessment of the quality-adjustment bias is based on a methodology proposed by Bils (2009), which uses the microdata underlying the CPI as well as consumer expenditure data. We report the findings of Kryvtsov (2011), who applies Bils' approach using price-survey microdata from Statistics Canada. According to this methodology, the rate of changes in prices (Δ) for CPI components is divided into three separate parts:

$$\Delta_{\text{unit price}} = \underbrace{\Delta_{\text{new goods}}}_{\text{during basket updates}} + \underbrace{\Delta_{\text{same model}} + \Delta_{\text{new model}}}_{\text{between basket updates}}$$

(i) (ii) (iii)

(i) the rate of price change for new types of goods (introduced during basket updates)

(ii) the rate of price change for the same models that occurs between basket updates

(iii) the rate of price change that occurs when new models of existing products replace older models between basket updates

When introducing new product categories to the CPI classification at the time of basket updates, a higher or lower price for these items would not translate into a potential for a positive or negative quality-adjustment bias, consistent with Bils' methodology. According to this approach, a quality-adjustment bias can therefore occur only between basket updates, when newer models of the same good are included in the CPI (the quality does not change for existing models).

We use two parameters to estimate the quality-adjustment bias: the share of the CPI components subject to quality adjustment, and the quality adjustment that should be applied to avoid this bias. We assume, as in previous Bank studies, that, on net, only durable goods are subject to this type of bias, given that such goods are the most likely to be affected by technological improvements.[27] Consequently, the net quality-adjustment bias arising from all of the other CPI components is assumed to be zero. The quality-adjustment bias in the total CPI would therefore equal the weight of durable goods in the Canadian CPI basket (12.8 per cent) multiplied by their annual quality-adjustment bias.

27 The assumption of a net bias of zero in the services sector is compatible with the possibility that some types of services, such as dental services, might be positively biased since they benefit from improved technology. This bias is offset by negative bias in other services, such as the airline industry, resulting from perceived decreases in the quality of service.

To calculate the extent of quality-adjustment bias, Bils (2009) examines the assumption that if higher prices for new models represented only inflation (no change in quality), this would lead to a complete substitution of these more expensive models with the older but more affordable ones. Bils rejects this assumption, finding instead an increase in the market share of these new models. Accordingly, the higher prices for new models could represent a combination of higher quality-adjusted prices and an improvement in quality. However, the initial price increase for new models might also represent a temporary increase in consumer demand due to the novelty of the product, which is eventually eliminated.[28]

To measure the importance of these effects, Bils (2009) and Kryvtsov (2011) estimate the persistence of the increase in relative prices for newly substituted models. Kryvtsov (2011) finds that one-third of the change in prices for durable goods, excluding computers, in Canada should be allocated to quality changes and two-thirds to pure price movements.[29] Since the quality adjustment performed by Statistics Canada is 40 per cent, slightly exceeding Kryvtsov's rule of thumb, there appears to be a modest negative quality-adjustment bias in the CPI. For computers, including both equipment and supplies, the quality-adjustment bias is assumed to be zero, based on Bils (2009) and Lebow and Rudd (2003).[30]

Table 3 shows detailed results for the quality-adjustment bias. The average price increase in Canada between 1998 and 2006 for changes in models is 1.6 per cent for durable goods, excluding computers.[31] According to Kryvtsov (2011), 0.5 per cent of this total should be attributed to quality adjustment to avoid any bias. However, he finds that 0.6 per cent has been allocated to quality adjustment, resulting in a negative bias of about -0.10 percentage point per year for durable goods, which has an impact on total CPI of -0.01 percentage point per year. Our estimate for quality-adjustment bias is much smaller than previous Bank studies largely because of the new method for assessing quality-adjustment bias for durable goods. The estimated upper limit of the quality-adjustment bias is obtained by allowing for a small net positive bias for components other than durable goods.

◂ *Our estimate for quality-adjustment bias is much smaller than previous Bank studies largely because of the new method for assessing quality-adjustment bias for durable goods*

Table 3: Quality-adjustment bias following model substitutions

CPI components	Weights (%)	Quality-adjustment bias (percentage points per year)	Impact on total CPI (percentage points per year)	Upper bound (percentage points per year)
Durable goods, excluding computers, equipment and supplies	12.20	-0.10	-0.01	
Computers, equipment and supplies	0.57	0.00[a]	0.00	
Total CPI except durable goods	87.20	0.00	0.00	
Mean estimate for total quality-adjustment bias	100.00		-0.01	0.05
Rossiter (2005)			0.15	0.20
Crawford (1998)			0.10	0.20

a. Based on a combination of Bils (2009) and Lebow and Rudd (2003)

28 When a new novel comes out, for example, people may prefer to read it right away because they do not want to hear the ending from someone who has already read it. In this case, demand for new novels will be higher (than for older ones), which leads to their relatively higher prices regardless of their quality.

29 Bils (2009) finds instead that, in the United States, the novelty premium accounts for about one-third of the initial price differential, while the remainder represents improved quality, suggesting that the increase in relative prices for newly substituted models is more persistent in the United States than in Canada.

30 Using U.S. data, this assumption is based on approximately the middle of the range between the slightly negative quality-adjustment bias that Bils (2009) found using the hedonic approach and the small positive bias that Lebow and Rudd (2003) found using a different sample period.

31 Data for the sample period were available only until 2006.

Measuring Total Bias in the CPI

From the total CPI bias, slightly more than half seems to be a result of the CPI basket being fixed

The total bias in the Canadian CPI can be estimated by aggregating the different sources of bias (**Table 4**). Our results indicate a total CPI bias in Canada of roughly 0.5 percentage point per year, with an upper bound of about 0.6 percentage point per year. From this total, slightly more than half seems to be a result of the CPI basket being fixed.[32] Our estimate of the bias is slightly lower than the estimate in Rossiter (2005), largely because of the new method for assessing quality-adjustment bias for durables. Our estimate relies on an improved methodology that uses Canadian CPI microdata instead of data from U.S. studies.

Table 4: Total bias in the Canadian consumer price index
Percentage points per year

Type of bias	Crawford (1998) Mean	Rossiter (2005) Mean	2005–11	
			Mean	Upper bound
Commodity substitution	0.10	0.15	0.22	0.22
Outlet substitution	0.07	0.08	0.04	0.06
New goods	0.20	0.20	0.20	0.26
Quality adjustment	0.10	0.15	-0.01	0.05
Total	**0.47**	**0.58**	**0.45**	**≈0.60**

Conclusion

Given that slightly more than half of the total measurement bias in the CPI may be caused by the fixed nature of the CPI basket, the commodity-substitution bias and some of the new-goods bias could be reduced by increasing the frequency at which weights are updated.[33] Although this might not always be the case, empirical evidence suggests that the average size of the measurement bias in the Canadian CPI has been relatively constant over the past 15 years. As well, since some of the divergence between our estimates of quality bias and those of previous studies appears to be related to improved methodology and better access to data specific to Canada, the difference in these estimates should not be attributed to a true decline in the underlying bias. Further analysis based on Canadian-specific data would enhance our empirical evidence of the size of the CPI bias.

It is important for central banks to be aware of both the level and the volatility of measurement bias in the CPI. In an inflation-targeting regime, measurement bias in the CPI can be accounted for by setting the target at a level that equals or exceeds the estimated bias to provide flexibility in insuring against deflation. This article has shown that the bias in the Canadian CPI remains below the rate of inflation targeted by the Bank of Canada.

32 More precisely, the fixed nature relates to both the commodity-substitution bias and some of the new-goods bias. Accordingly, the sum of the commodity-substitution bias and the fraction of the new-goods bias resulting from the delay in adjusting weights is 0.23 percentage point per year.

33 As part of a larger CPI enhancement project, Statistics Canada is planning to update the CPI basket weights every two years, instead of every four years.

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Global Risk Premiums and the Transmission of Monetary Policy

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- An important channel in the transmission of monetary policy is the relationship between the short-term policy rate and long-term interest rates.
- Using a new term-structure model, we show that the variation in long-term interest rates over time consists of two components: one representing investor expectations of future policy rates, and another reflecting a term-structure risk premium that compensates investors for holding a risky asset.
- The time variation in the term-structure risk premium is countercyclical and largely determined by global macroeconomic conditions. As a result, long-term rates are pushed up during recessions and down during times of expansion. This is an important phenomenon that central banks need to take into account when using short-term rates as a policy tool.
- We illustrate this phenomenon by showing that the "conundrum" observed in the behaviour of long-term interest rates when U.S. monetary policy was tightened during the 2004–05 period was actually part of a global phenomenon.

As part of their monetary policy decision making, central banks set the level of a short-term (overnight) policy interest rate. Understanding the effects of policy changes on the economy, however, requires an examination of the entire monetary policy transmission mechanism. An important channel in the transmission of monetary policy is the relationship between the short-term policy rate and long-term interest rates. Long-term rates are a key component of monetary policy, since they represent part of the cost of borrowing for consumers and the cost of capital for businesses (Dorich, Mendes and Zhang 2011).[1]

This article uses a new model (Bauer and Diez de los Rios 2012) to examine the determinants of long-term interest rates in developed countries. The model can be used to decompose long-term rates into two components. The first component is the market's expectation of future policy (i.e., short-term) interest rates. The price of a long-term bond today reflects investors' beliefs

1 A given project is likely to have both short-term and long-term cash flows that should be discounted using an interest rate of the same maturity. Thus, the long-term interest rate will be a key part of the total cost of capital for households and firms. In this article, we do not explore the role of the exchange rate, which is an important additional component of monetary policy.

about future central bank actions. If a central bank gives signals about its future policy direction (either by actions taken today or by changes in its communication to markets), expectations of future policy rates will adjust, which will, in turn, cause a movement in current long-term interest rates.

The second component is the extra return that investors demand for holding a risky asset. Our analysis shows that this component is driven largely by global macroeconomic conditions. In particular, it is strongly countercyclical, rising sharply during global recessions and falling during global expansions. This is an important phenomenon that central banks must consider in their monetary policy decision-making process. For example, markets may be pushing down long-term interest rates at the same time that tightening by central banks would be acting to raise them. Thus, in order to have the required effect on long-term rates, a larger move in the short-term policy rate may be necessary. We illustrate this later in the article by providing an explanation from a global perspective for the "conundrum" regarding the behaviour of long-term interest rates first described by then U.S. Federal Reserve Chairman Alan Greenspan during the 2004–05 period (Greenspan 2005). We also point out that, with the current low levels of long-term interest rates, the variation in the risk premium over time is an even larger component of long-term rates.

We limit our analysis to the transmission of conventional monetary policy actions on the long end of the default risk-free yield curve. We do not examine unconventional policies (e.g., the Federal Reserve's quantitative-easing measures) that may influence current levels of long-term interest rates, since they are examined more closely in other work.[2] In addition, we do not explore the implications of either conventional or unconventional policies on foreign exchange rates, credit markets and other potential channels of transmission.

Understanding the Drivers of Long-Term Interest Rates

In our model, we use the 10-year interest rate on zero-coupon bonds ($y_{j,t}^{(10)}$) as the long-term interest rate measured at time t for four countries: j = the United States, Canada, the United Kingdom and Germany.[3] The long-term rate is decomposed into two terms in the following equation:

$$y_{j,t}^{(10)} = \frac{1}{10}\sum_{h=1}^{10} E_t\, y_{j,t+h-1}^{(1)} + tp_{j,t}^{(10)}. \quad (1)$$

The first term involves market *expectations*, that is, the average expected 1-year interest rate over the next 10 years. In our model, we use the 1-year interest rate in country j as a proxy for that country's policy rate.[4] Observed yields will, on average, equal the expectations component only under the "expectations hypothesis," which has been statistically rejected in many studies.[5]

2 See Kozicki, Santor and Suchanek (2011).

3 A zero-coupon bond is a claim that sells at a price today and yields a payment of $1 at maturity. Investors thus earn a yield on the bond by buying at a price of less than $1 today and holding the bond to maturity. The yield on the zero-coupon bond can be calculated from prices of regular coupon-bearing bonds observed in the market. We use bonds issued by Germany to represent the euro area. The model is estimated over the January 1975 to December 2011 period.

4 A country's 1-year rate can be viewed as being closely related to the current (short-term) policy rate that is targeted by that country's central bank, as well as to the expectations of near-term policy moves.

5 See Campbell and Shiller (1991); Bekaert and Hodrick (2001); and Sarno, Thornton and Valente (2007).

The rejection of the expectations hypothesis is typically attributed to the existence of the second term in equation (1), a time-varying *term-structure risk premium*. The risk premium represents the extra compensation that investors require for holding a 10-year bond. In our model, agents hold portfolios for one year, and the prices of long-term bonds may change considerably over that period, necessitating a higher expected rate of return. Several studies have focused on the properties of the term-structure risk premium (see Cochrane and Piazzesi (2005) and their references).

Our term-structure model (Bauer and Diez de los Rios 2012) separates the observed long-term interest rate into these two unobserved components and captures the relationship between fundamental economic forces (i.e., real growth and inflation) and the cross-section of international bond yields and exchange rates. The model enforces a "no-arbitrage" condition across all of the assets so that risk-free arbitrage (i.e., a free lunch) is ruled out.

The model incorporates three key aspects of real-world financial markets. First, the cross-section of yields in the international bond market may be explained by a combination of global and local (country-specific) factors. The global factors include a level factor (the average level of interest rates across all countries and maturities) and a slope factor (the average difference between long- and short-term interest rates across all countries). The model's no-arbitrage condition uses both global and local factors to explain international yield curves at a single point in time (the yields shown on the left side of equation (1)).

The second real-world aspect of the model consists of the constraints placed on the time-varying risk premium, the second component of equation (1).[6] Previous work has shown that imposing restrictions on the term-structure risk premium makes the forecast values of interest rates more realistic than those in unrestricted models.[7] Our model restricts risk premiums on bonds through its assumption of global asset pricing; i.e., in integrated international markets, only global risks carry significant risk premiums. As a result, the term-structure risk premium on any bond is driven by the bond's exposure to the global level and slope factors only. The local factors, while helping to explain prices at a point in time, do not affect expected returns (i.e., changes in prices), since investors can eliminate their effects by diversifying with a global portfolio.[8]

The third real-world aspect of the model is that it shows how the prices of the global risks change over time. The level factor is driven by expected global inflation (an average of expected inflation across all countries), while the slope factor is driven by an estimate of real global economic growth (industrial production). Thus, changes in these macroeconomic conditions will affect the expected returns on long-term bonds across all four countries in the model.

6 Technically, the restrictions are imposed on the expected return for the 1-year holding period of the bonds (i.e., the return from buying a 10-year bond today and selling it one year later). The 10-year term-structure risk premium in equation (1) is the sum of the expected 1-year holding-period returns over the next 10 years.

7 Since realized returns are quite variable, the simple regressions that are used to capture expected returns (i.e., risk premiums) are prone to several forms of small-sample bias; statistical restrictions may therefore aid in the identification of expected returns. See Bauer, Rudebusch and Wu (2011).

8 We also impose maximum Sharpe ratios on investments in international bond markets, reflecting the limited nature of real-world investment possibilities. A Sharpe ratio is the ratio of the expected excess return on the bond divided by its standard deviation. The ratio thus shows the extra expected return per unit of risk in the investment. No-arbitrage term-structure models are likely to yield bond portfolios with unrealistically high Sharpe ratios, owing to the large number of parameters that may lead to the over-fitting of returns in sample (Duffee 2010).

When the model imposes the restrictions described above, it generates forecasts of interest rates that match those from survey data. When the restrictions are not imposed, the forecasts differ. In particular, when local factors are allowed to have a large influence on the dynamics of the rates, the model produces unrealistic forecasts. This suggests that the assumption of global asset pricing is reasonable.

We use this restricted model to decompose long-term interest rates as in equation (1). **Chart 1** shows the time series of the expectations component of the long-term yield in each of the four countries since 1975. The grey bars indicate a recession period in the United States, as identified by the National Bureau of Economic Research (NBER).[9] The chart shows the long-run decline in market expectations as policy rates gradually fell from the very high levels reached during the early 1980s, when the U.S. Federal Reserve and other central banks raised short-term interest rates in an attempt to slow inflation. Following the dramatic reduction in inflation, long-term interest rates gradually declined.

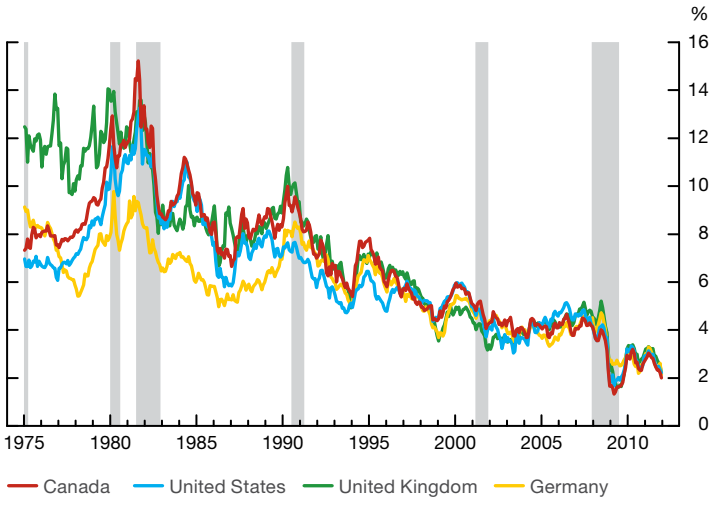
There was a long-run decline in market expectations as policy rates gradually fell from the very high levels reached during the early 1980s

The model also shows a great deal of variation in the second component of the decomposition, the term-structure risk premium (**Chart 2**). The effects of global macroeconomic conditions are seen in two features of the risk premiums. The first is a long-run structural decline, reflecting the reduction in both the level and volatility of global inflation.[10] From the early 1980s to the mid-2000s, risk premiums declined steadily, with reversals during recessionary periods.

The second feature is the strong countercyclical behaviour of the risk premiums. Term-structure risk premiums are driven by variations in real global economic growth over time, which affect an investor's desire to hold risky assets. Hence, global risk premiums have been low before recessions, when growth is still quite strong. Indeed, these premiums reached negative levels during the 2005–08 period leading up to the collapse of Lehman Brothers

Term-structure risk premiums are driven by variations in real global economic growth over time, which affect an investor's desire to hold risky assets

Chart 1: Estimated expectations component of yields on 10-year zero-coupon government bonds



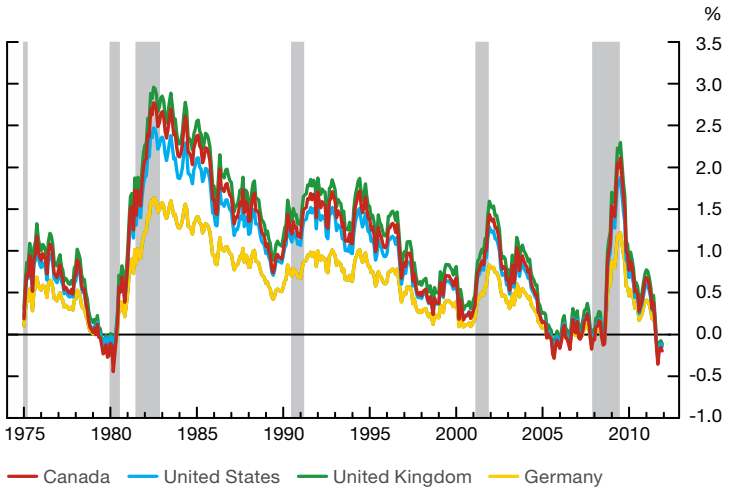
Note: The grey bars represent recession periods in the United States, as identified by the National Bureau of Economic Research.

Source: Bauer and Diez de los Rios (2012) Last observation: December 2011

9 We use the NBER recession dates as a proxy for global recessions.

10 Joslin, Priebsch and Singleton (2010) and Wright (2011) find a similar long-run decline. Wright (2011) suggests that the decline may also be the result of less uncertainty regarding inflation rates.

Chart 2: Estimated term-structure risk-premium component of yields on 10-year zero-coupon government bonds



Note: The grey bars represent recession periods in the United States, as identified by the National Bureau of Economic Research.

Source: Bauer and Diez de los Rios (2012) Last observation: December 2011

and the subsequent financial crisis.[11] In contrast, risk premiums rise sharply in recessionary periods; at these times, output and consumption fall, which results in an increase in the value that investors place on marginal units of output. Thus, compensating investors for holding a risky asset requires a decrease in the price of the asset or an increase in its yield. Several studies have shown that the term-structure risk premium is countercyclical (Cochrane and Piazzesi 2005; Joslin, Priebsch and Singleton 2010).[12]

Monetary Policy and the Global Risk Premium

Our model highlights the importance of examining the influence of global asset markets when projecting movements of long-term interest rates in the context of expected monetary policy decisions. To investigate the effects of time-varying risk premiums, we focus on relatively short periods to reduce the influence of the long-run downward trend.

When the U.S. Federal Reserve increased its policy rate in an attempt to slow growth and reduce inflationary pressures during the 2004–05 period, to the surprise of Federal Reserve officials, long-term U.S. interest rates remained stable. Alan Greenspan, then Federal Reserve Chairman, described this behaviour as a "conundrum," because existing models of the U.S. term structure could not explain the movements in the yield curve (Greenspan 2005). Later studies have indicated that the U.S. term-structure

11 The low level of risk premiums (expected excess returns) on "safe" (i.e., AAA-rated) bonds before 2008 may have caused some investors or financial intermediaries to "search for yield," that is, to invest in riskier securities or projects. The search-for-yield phenomenon is of concern to policy-makers, since it is questionable whether all of the investment decisions being made fully take into account the risks involved (e.g., Cociuba, Shukayev and Ueberfeldt 2011).

12 Other researchers have advocated that global imbalances caused declines in term premiums in the mid-2000s. According to this view, there was an increase in the demand for highly rated U.S. assets (by foreign exchange reserve managers in emerging-market central banks and others) following the Asian financial crisis of 1997–98. This increase in demand caused a decline in global term premiums (e.g., Caballero, Farhi and Gourinchas 2008). While we do not deny that global imbalances may have played a role in the recent decline in term premiums, we note that premiums were declining during the expansions of the 1970s, 1980s and 1990s, when global imbalances had yet to emerge. Similarly, we also note the large increases in the term premiums during recessions.

risk premium was falling at the time, helping to offset the impact of the Fed's actions on long-term interest rates (Backus and Wright 2007; Cochrane and Piazzesi 2008; Kim and Wright 2005; Kozicki and Sellon 2005; Rudebusch, Swanson and Wu 2006).

The risk-premium explanation of the U.S. conundrum can be viewed as a global phenomenon

In Bauer and Diez de los Rios (2012), we show that the risk-premium explanation of the U.S. conundrum can be viewed as a global phenomenon; that is, it was present across term structures in several countries. **Table 1** shows the actual short-term (1-year) and long-term (10-year) interest rates on zero-coupon bonds, as well as the model's estimated 10-year rate, market expectations and the risk premium, in May 2004 and July 2005. As is evident in the first column, the increase in the Federal Reserve's policy rate corresponded with a rise in the short-term rate from 1.64 per cent to 3.86 per cent. The long-term rate fell, however, from 4.74 per cent to 4.33 per cent.

Table 1: Changes in short- and long-term interest rates, May 2004 to July 2005

	Actual 1-year yield (%)	Actual 10-year yield (%)	Fitted 10-year yield (%)	Expectations component (%)	Term-structure risk premium (%)
United States					
May 2004	1.64	4.74	4.74	4.05	0.69
July 2005	3.86	4.33	4.44	4.46	-0.02
Change (in basis points)	*222.00*	*-41.00*	*-30.41*	*41.33*	*-71.74*
Canada					
May 2004	2.13	4.78	4.84	4.07	0.77
July 2005	2.88	3.96	3.83	3.89	-0.06
Change (in basis points)	*75.00*	*-82.00*	*-101.62*	*-18.04*	*-83.58*
United Kingdom					
May 2004	4.47	4.96	4.94	4.05	0.89
July 2005	4.21	4.29	4.26	4.22	0.04
Change (in basis points)	*-25.83*	*-66.81*	*-67.95*	*17.00*	*-84.95*
Germany[a]					
May 2004	2.17	4.40	4.42	3.97	0.45
July 2005	2.14	3.26	3.34	3.39	-0.05
Change (in basis points)	*-2.50*	*-113.80*	*-108.45*	*-57.98*	*-50.47*

a. We use interest rates on bonds issued in Germany to represent the euro area.
Source: Bauer and Diez de los Rios (2012)

The model explains why the policy actions of the Fed did not result in higher long-term rates. The expectations component of the 10-year U.S. yield rose over the same period, from 4.05 per cent to 4.46 per cent. Thus, the 222-basis-point rise in short-term rates led market participants to increase their expectations regarding the future path of the policy rate by 41 basis points. However, since the economy was expanding and conditions were expected to be favourable, the term-structure risk premium for U.S. Treasuries fell by almost 72 basis points. It is important to note that this was a global phenomenon: the risk premium on the long-term yields in each of the four countries fell, even though other central banks were either raising short-term interest rates (Canada) or leaving them close to their starting levels (the United Kingdom and Germany).

We can also estimate the influence of the global risk premium during recessions. **Table 2** shows the change in the policy rate and the long-term interest rate in each of the four countries during five periods officially identified

as recessions in the United States by the National Bureau of Economic Research. In each of the five periods, central banks attempted to ease monetary conditions by lowering short-term interest rates. For the most part, long-term interest rates fell at the same time, driven largely by decreases in the expectations regarding yields over the long term. For example, during the 1981–82 recession, the Federal Reserve lowered short-term U.S. rates by 476 basis points, and the 10-year yield fell by 262 basis points. The model suggests that the Fed was able to lower the expectations for the 1-year yield over the 10-year horizon by 280 basis points. At the same time, however, the risk premium rose, putting upward pressure on long-term U.S. rates by 69 basis points. This offsetting effect of the global term-structure risk premium is common across countries: it rises during recessionary periods, putting upward pressure on interest rates on the long-term bonds, which are more exposed to this risk.

This effect is evident during the financial crisis of 2007–09. While short-term U.S. rates fell by 263 basis points, long-term U.S. rates decreased by a mere 23 basis points. This occurred because, although the Fed succeeded in lowering expectations of future policy moves by 224 basis points (**Table 2**),[13] the term-structure risk premium rose by 190 basis points.

◀ *The offsetting effect of the global term-structure risk premium is common across countries: it rises during recessionary periods, putting upward pressure on interest rates on the long-term bonds, which are more exposed to this risk*

Table 2: Changes in short- and long-term interest rates during U.S. recessions
In basis points, from the beginning to the end of the recession dates, as identified by the National Bureau of Economic Research

	Actual 1-year yield	Actual 10-year yield	Fitted 10-year yield	Expectations component	Term-structure risk premium
United States					
December 1979–July 1980	-219	34	64	-9	73
June 1981–November 1982	-476	-262	-211	-280	69
June 1990–March 1991	-157	-27	-24	-45	21
February–November 2001	-246	-3	1	-81	81
October 2007–June 2009	-263	-23	-34	-224	190
Canada					
December 1979–July 1980	-100	13	37	-46	83
June 1981–November 1982	-889	-486	-484	-564	80
June 1990–March 1991	-294	-73	-87	-111	24
February–November 2001	-237	1	17	-77	94
October 2007–June 2009	-329	-46	-37	-255	218
United Kingdom					
December 1979–July 1980	-133	-120	-141	-225	84
June 1981–November 1982	-199	-242	-249	-333	84
June 1990–March 1991	-272	-109	-109	-133	25
February–November 2001	-111	-6	-16	-113	97
October 2007–June 2009	-414	-94	-91	-318	226
Germany[a]					
December 1979–July 1980	-20	-15	-4	-54	50
June 1981–November 1982	-526	-180	-179	-225	47
June 1990–March 1991	22	-31	-32	-46	14
February–November 2001	-125	-5	1	-55	56
October 2007–June 2009	-310	-46	-45	-172	127

a. We use yields on bonds issued in Germany to represent the euro area.
Source: Bauer and Diez de los Rios (2012)

13 This may be the result of the Fed's unconventional policy actions.

While the financial crisis may have originated elsewhere, it is clear that Canada was not completely isolated from its influence. The Bank of Canada reduced its policy rate, which translated into a 329-basis-point decline in the actual 1-year interest rate used in the model. However, Canadian long-term interest rates were clearly affected by global macroeconomic conditions and the resulting policy moves, both at home and abroad. For example, our model indicates that, at the end of 2011, investors in Government of Canada bonds anticipated that 1-year rates would average 2.01 per cent over the next 10 years (**Chart 1**). Canadian long-term interest rates are also affected by the low level of the global term-structure risk premium, with the estimated risk-premium component in Canada falling to just below zero at the end of 2011 (**Chart 2**).

Concluding Remarks

The analysis in this article demonstrates the extent to which the global term-structure risk premium as well as monetary policy actions influence long-term interest rates. The risk premium is countercyclical to the global business cycle and thus may affect long-term interest rates in the opposite direction to that related to central bank policy actions. As a result, central banks need to take these forces into account in appropriately calibrating their policy response. Indeed, given the current low level of long-term rates, understanding movements in the global risk premium is important for the monetary policy decision-making process.

Since monetary policy may affect expectations and the term-structure risk premium differently, the levels of these two components may, in turn, affect the macroeconomy in various ways. For these reasons, understanding the effects on growth and inflation of movements in market expectations and the global term-structure risk premium is an important aim for future research.

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An Analysis of Indicators of Balance-Sheet Risks at Canadian Financial Institutions

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- This article compares different types of Canadian financial institutions by examining over time ratios that are indicators of four balance-sheet risks—leverage, capital, asset liquidity and funding.
- The various risk indicators have decreased during the past three decades for most of the non-Big Six financial institutions in our sample and have remained relatively unchanged for the Big Six banks, resulting in increasing heterogeneity in these indicators of balance-sheet risks.
- The observed overall decline and increased heterogeneity in the risk indicators follow certain regulatory changes, such as the introduction of liquidity guidelines on funding in 1995 and the implementation of bank-specific leverage requirements in 2000. This suggests that regulatory changes have had significant and heterogeneous effects on the management of balance sheets by financial institutions and, given that these regulations required more balance-sheet risk management, they contributed to the increased resilience of the banking sector.

An important function of the Bank of Canada is to promote the safety and efficiency of the financial system in Canada. In support of this mandate, research and policy analysts at the Bank investigate the overall soundness of the Canadian banking sector, its role in the Canadian financial system and its important links with the real economy.

Recent regulatory reforms in the banking sector under Basel III[1] are aimed at promoting the resilience of banks and the overall banking system, based on the hard lessons learned from the recent financial crisis, which demonstrated that many banks in advanced economies were undercapitalized, illiquid and over-leveraged.[2] While Basel III pays particular attention to large, internationally active banks, financial institutions of various sizes can play different and sometimes systemic roles.[3] In particular, smaller banks often fill certain niches; for example, they may have a disproportionate presence in the interbank market or in payment and settlement systems. These banks tend to have less-diversified portfolios and more-concentrated operations

1 Basel III is a set of minimum regulatory requirements (regarding, for example, capital, liquidity and leverage) for global financial institutions. See BCBS (2011).

2 While the banking sector in Canada fared better during the crisis than those in other advanced economies, the country experienced some liquidity and funding pressures.

3 See Allen and Gale (2000), Chan-Lau (2010), and Gauthier et al. (2011).

geographically.[4] Thus, they may be more vulnerable to sector-specific or region-specific shocks than larger banks with well-diversified portfolios that are located within a broader geographic area.[5]

This article explores the similarities and differences in risks to the balance sheets of various financial institutions. We examine four important ratios—leverage, capital, asset liquidity and funding—that measure risks to bank balance sheets for two groups of financial institutions, based on their size and charter type. While many studies of Canadian financial institutions focus on the Big Six banks, this analysis provides a broader view that encompasses the entire banking sector. We also discuss how these risk indicators have evolved over the past three decades and describe relevant developments in banking sector regulation that could have contributed to the observed dynamics.

Data and Bank Groups

Our data set for Canadian financial institutions is based on financial regulatory reports, collected jointly by the Bank of Canada, the Office of the Superintendent of Financial Institutions Canada (OSFI) and the Canada Deposit Insurance Corporation.[6] Our sample contains the regulatory financial reports of all of the 156 federally chartered deposit-taking institutions, both active and inactive.[7]

We divide our sample into two broad categories: the Big Six banks and other financial institutions (non-Big Six banks). The latter group is further subdivided in two ways: by total asset size (large, medium and small) and by charter type (foreign subsidiaries, other domestic banks, and trust and loan companies).[8, 9]

Table 1 provides summary statistics of our sample. In August 2011, the combined total assets of the Big Six banks accounted for about 90 per cent of the total assets of all of the institutions studied. The majority of non-Big Six assets are concentrated among the larger institutions.[10] The Big Six banks are more diversified geographically than other institutions, as shown in the last two rows of the table: they are active in all 10 provinces and, as a group, have the lowest percentage of their total assets located in Ontario,

4 Berger et al. (2005), for example, argue that small banks tend to follow a model that involves "relationship lending," which requires more information than simply what credit scores and financial records reveal. This model makes it easier for small banks to lend to certain types of borrowers that may otherwise find it difficult to obtain credit.

5 "Despite their small size, the Canadian Commercial Bank (CCB) and Northland Bank failures in 1985 were seen to have had the potential to adversely affect the broader Canadian banking system" (Illing and Liu 2003, 9).

6 Data since 1996 are publicly available from OSFI at <http://www.osfi-bsif.gc.ca/osfi/index_e.aspx?ArticleID=554>.

7 It excludes consolidated subsidiaries of other deposit-taking institutions in the data set (to avoid double counting) and foreign bank branches, since they are not required to hold equity. Without equity, it is not possible to calculate leverage or capital ratios. For more details on sample selection, see Chen et al. (forthcoming).

8 We divide the non-Big Six banks equally into three groups by size on a monthly basis. In August 2011, the large financial institutions were those valued at more than $2.2 billion; the medium-sized were those valued at between $0.2 billion and $2.2 billion; and the small were those valued at less than $0.2 billion.

9 Other domestic banks are Canadian banks, while foreign subsidiaries are foreign banks with a Canadian charter. Trust and loan companies have traditionally concentrated on residential mortgages and term deposits, at least until the 1990s (Freedman 1998). See **Appendix 1** of this article on page 32 for a list of active financial institutions in each category in August 2011.

10 Financial institutions from each charter type are represented among the large financial institutions. See Appendix 1.

the largest province.[11] In contrast, the other groups of institutions are active in a smaller number of provinces and hold a higher proportion of their assets in Ontario. This is especially true for foreign subsidiaries, which are the least geographically diversified among the three charter types, despite accounting for more than half of the assets in the non-Big Six category.

Table 1: Summary statistics of the Canadian financial institutions in our sample

		Non-Big Six banks					
	Big Six banks	Large	Medium	Small	Foreign subsidiary	Other domestic bank	Trust and loan company[a]
Assets (in $ billions), August 2011							
Total	3,076.1	284.2	16.3	1.5	165.8	73.6	62.6
Average	512.7	14.2	0.8	0.1	8.7	4.9	2.4
Number of banks, January 1983–August 2011							
Average	6.0	20.0	20.0	21.0	41.0	7.0	23.0
Geographical concentration, January 1983–August 2011							
Number of provinces in which assets are located	10.0	6.0	4.4	2.7	3.8	6.7	6.2
Percentage of assets in Ontario	20.0	33.8	41.5	38.4	41.6	24.7	32.9

a. Data on the number and geographical concentration of trust and loan companies date from 1996.
Source: Office of the Superintendent of Financial Institutions Canada

Analysis of Indicators of Balance-Sheet Risks

Four measures of risks to bank balance sheets

Our analysis focuses on four important ratios that capture different balance-sheet risks.[12]

A *leverage ratio* measures risk associated with non-capital funding of overall balance sheets. It is a simple and transparent measure of balance-sheet risk, not subject to the model and measurement errors associated with asset-risk calculations. It is defined as:

> Leverage ratio = Total assets/(Total shareholders' equity + subordinated debt).[13]

Other things being equal, a higher ratio is associated with greater vulnerability to adverse shocks that reduce the overall value of assets or funding liquidity.[14]

11 The percentage of Big Six assets in Ontario (20 per cent) may appear very low, since their assets are more geographically dispersed in other provinces and in foreign countries than are those of non-Big Six institutions. In addition, some assets are not associated with a particular location (such as intangible assets), lowering the percentages of location-specific assets.

12 A complete assessment of bank risk requires a full range of analyses (including, for example, a bank's provision for loan losses and mismatches of asset-liability maturity). In this article, however, we focus only on the four ratios that reflect the risk dimensions considered in the Basel III framework.

13 This definition is close to the regulatory leverage ratio used by OSFI, which is based on total regulatory capital as defined in Basel II, including subordinated debt (Bordeleau, Crawford and Graham 2009). Starting in 2013, when Canadian banks begin implementing the Basel III rules, the calculation of total regulatory capital will be slightly altered. For example, it will include deductions of defined-benefit pension funds, mortgage servicing rights and deferred tax assets.

14 Excessively high leverage could increase a bank's reliance on potentially volatile short-term sources of funding and expose it to higher funding liquidity risk (Bordeleau, Crawford and Graham 2009).

A *capital ratio* captures risks associated with bank assets. We focus on the Tier 1 capital ratio, defined as follows:

> Tier 1 capital ratio (%) = 100 x Adjusted net Tier 1 capital/Total risk-weighted assets.[15]

A higher capital ratio implies that a bank has relatively high capital holdings or relatively low holdings of risky assets, and is associated with less vulnerability to adverse shocks. Even if their balance sheets are the same size and they have the same amount of capital, i.e., their leverage ratios are equal, two institutions with different asset mixes can have different capital ratios.

Both the leverage ratio and the capital ratio focus on whether the bank has sufficient capital to support its assets. However, the recent financial crisis highlighted the fact that having sufficient capital alone is not a precondition for stability. Funding liquidity and asset liquidity are also important determinants of the ongoing viability of a bank.[16] We therefore constructed ratios that capture the asset liquidity risk and funding liquidity risk of banks. Because of constraints on the data available for a historical analysis, these ratios are different and less complex than those proposed in the Basel III liquidity requirements.[17]

Having sufficient capital alone is not a precondition for stability. Funding liquidity and asset liquidity are also important determinants of the ongoing viability of a bank

Our third measure of risk, an *asset-liquidity ratio*, is defined as follows:[18]

> Asset-liquidity ratio (%) = 100 x (Cash and cash equivalents + public securities + secured short-term loans)/Total assets.

The higher the asset-liquidity ratio, the more an institution is able to withstand adverse shocks that increase the need to liquidate assets. If an institution holds less-liquid assets, its ability to withstand those shocks may be impaired.

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15 Adjusted net Tier 1 capital generally includes, but is not limited to, equity and disclosed reserves, including retained earnings. Total risk-weighted assets are assets that have been adjusted to reflect their risk according to the Basel framework. Data for the Tier 1 capital ratio have been available on a quarterly basis only since 1994, after the implementation of Basel at the end of 1992. With the Basel II framework, calculation of the two components of the Tier 1 capital ratio has been modified to include consideration of market risk since 1997 and an option for financial institutions to use their own risk-assessment models (with OSFI's approval) since 2008. Under Basel III, calculation of the two components of the Tier 1 capital ratio will be modified to include a new deduction to capital (see footnote 13) and higher weighting for market-risk components in the risk-weighted assets.

16 During the crisis, liquidity in short-term funding markets dried up in the United States, the United Kingdom, the euro area and, to a much smaller degree, Canada. Consequently, banks found it difficult to fund their assets. An asset fire sale resulted as banks sold off assets they could no longer fund. With the introduction of the Basel III requirement, banks will have to report and satisfy certain levels of regulatory liquidity and funding ratios, known as the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR). The liquidity rules are aimed at measuring banks' resilience to short-term liquidity stress, with requirements set to ensure that banks have access to stable funding sources. For more details, see BCBS (2010) and Gomes and Khan (2011).

17 Our asset-liquidity and funding ratios separately capture liquidity risk on each side of the balance sheet. In comparison, the proposed liquidity standards in Basel III consider both sides of the balance sheet together and incorporate more complex assumptions on funding runoffs (e.g., sudden withdrawal of bank liabilities) and haircuts (i.e., a percentage difference between the market value of an asset and its value as collateral).

18 This ratio reflects a liquidity buffer and does not account for haircuts or interest and principal cash flows, as currently prescribed in the LCR.

Finally, we define a *funding ratio* as the proportion of a bank's total assets that are funded by wholesale funding (a relatively less stable funding source than retail (personal) deposits, for example):[19]

Funding ratio (%) = 100 x (Non-personal deposits + repos)/Total assets.[20]

A higher funding ratio indicates that a bank relies on greater market-based funding and is therefore more exposed to adverse shocks in the market that could disrupt continuous funding of its assets.

Although these indicators are informative regarding risks to bank balance sheets, caution should be taken when using these ratios to measure relative risks across groups of institutions. High risk, as indicated by a particular ratio, may also reflect regulatory or supervisory latitude granted to an individual institution based on its strong risk-management practices. In this article, we use the terms "higher" or "lower" risk, assuming that such supervisory requirements remain constant.

Overall dynamics of the indicators of balance-sheet risks

Non-Big Six financial institutions have become more resilient over time

Chart 1 shows the evolution of the four ratios that indicate balance-sheet risks for the financial institutions in our sample. Overall trends suggest that non-Big Six institutions have become more resilient over time. Capital has increased, and both leverage and funding risk have decreased. For the Big Six banks, capital ratios increased moderately until 2008, when the trend became more positive. Their leverage ratios declined in the 1980s, and then exhibited an increasing trend until 2008, when the recent financial crisis hit the Canadian economy. Asset-liquidity and funding ratios for the Big Six banks are either stable or display no long-term trend.

Several regulatory changes in the financial sector can partly explain movements in indicators of balance-sheet risks

Several regulatory changes in the financial sector in recent decades can partly explain these movements. For example, the introduction of bank-specific regulatory limits on leverage in 2000 likely contributed to the observed widening in the dispersion of the leverage ratios for the two groups.[21] The gradual decrease in leverage among the non-Big Six banks during the late 1990s could be the result of consolidation. After the 1992 amendments to the Bank Act, allowing cross-ownership between chartered banks and trust and loan companies, the Big Six acquired several trust and loan companies. If these institutions were highly leveraged, their acquisition and removal from the non-Big Six sample (since they became subsidiaries) may have reduced the group's overall leverage.[22]

19 Unlike the NSFR, this definition of the funding ratio does not differentiate among the terms of funds or the risks of assets.

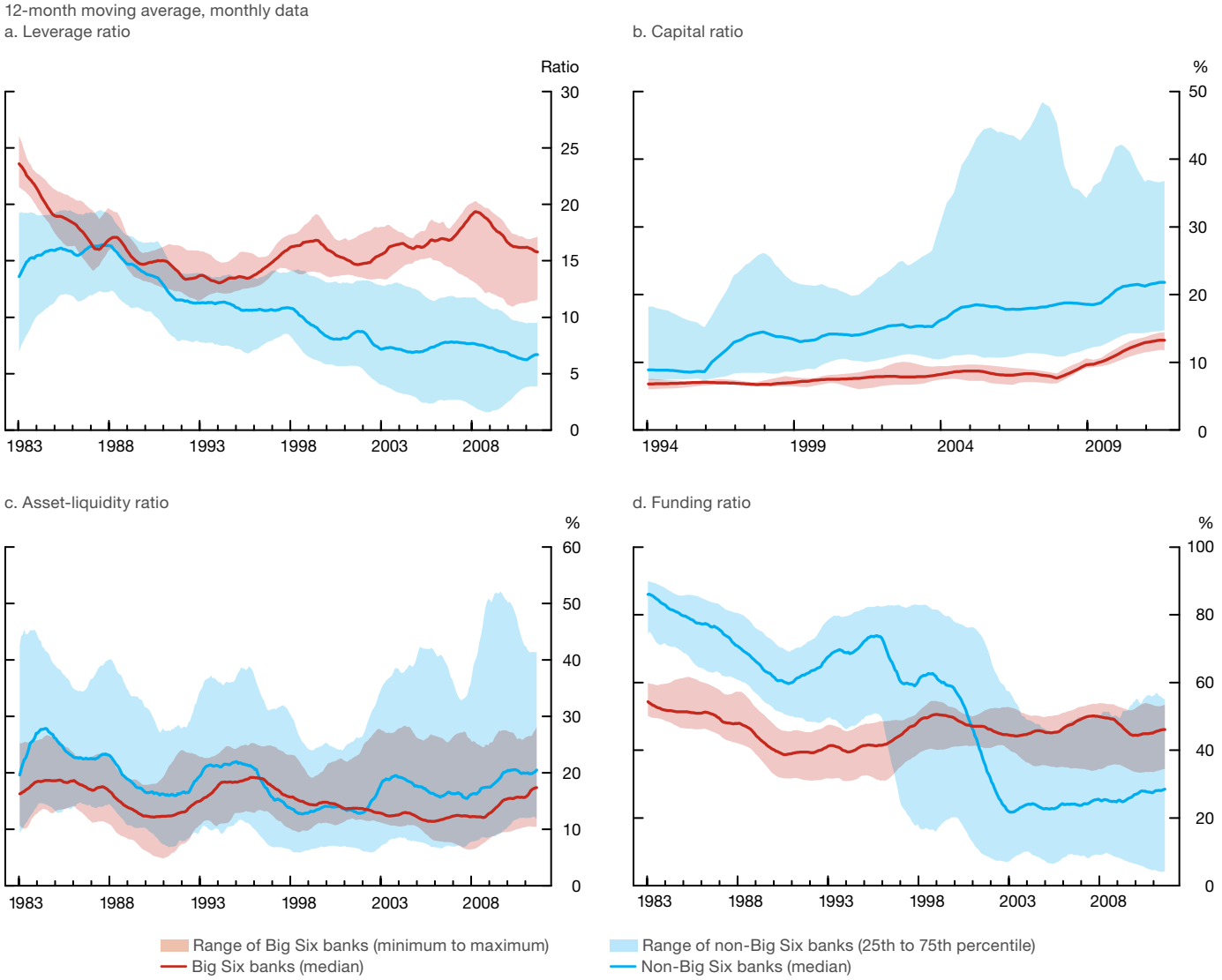
20 Non-personal deposits (i.e., a category in the regulatory report on balance sheets) include market-based funding, such as commercial paper, bankers' acceptances and deposit notes.

21 With the introduction of the regulatory leverage ratio in 1982, OSFI imposed a formal limit on banks. This limit, known as the assets-to-capital multiple (ACM) limit, has since changed over time and, in 2000, became specific to individual institutions. Smaller institutions are typically allowed to have lower limits than their larger counterparts.

22 Analysis of only the financial institutions that continued operations throughout the data period also reveals a divergent trend between the Big Six and the other institutions, although to a lesser degree, suggesting that acquisitions of non-Big Six institutions by the Big Six banks partly contributed to the observed divergence. In addition to trust and loan companies, several Canadian investment dealers (that were not included in the data set) were acquired by the Big Six banks in the late 1980s, e.g., Dominion Securities by the Royal Bank of Canada and Nesbitt Thomson by the Bank of Montreal. However, these acquisitions do not appear to have significantly increased the leverage of their parent institutions.

Chart 1: Indicators of balance-sheet risks at Canadian financial institutions

12-month moving average, monthly data



Note: Panel d includes only institutions with wholesale funding.

Source: Office of the Superintendent of Financial Institutions Canada

Last observation: August 2011

Another notable regulatory change was the increase in the minimum capital requirement mandated by OSFI in 1999, which raised the minimum requirement for the Tier 1 capital ratio from 4 per cent (the standard specified in Basel I) to 7 per cent, contributing to the trend rise in capital. The sharp decline in the funding ratio for the non-Big Six banks in the late 1990s can be explained, in part, by the introduction of liquidity guidelines by OSFI in 1995,[23] which required institutions with high reliance on market-based funding to have strict liquidity-risk-management practices.[24]

23 See OSFI guidelines on liquidity at <http://www.osfi-bsif.gc.ca/osfi/index_e.aspx?DetailID=527>.

24 This decline in the funding ratio is reinforced by the inclusion of trust and loan company data in 1996, which, on average, exhibit low funding ratios. In addition, dynamics regarding mergers, exits and charter changes of foreign subsidiaries (e.g., from a foreign subsidiary to a foreign branch) appear to have played some role in the decline of funding ratios around 2000. Regardless of these other factors, however, a decline in funding ratios is observed around the time of the introduction of the liquidity guidelines.

Heterogeneity of these indicators within the banking system (as measured by the differences between the Big Six and the other financial institutions, as well as by the differences among the non-Big Six institutions) has generally increased since the mid-1990s. This may be due, in part, to greater discipline imposed by markets or to regulations that have become increasingly bank-specific, implying a more appropriate alignment of these balance-sheet ratios with the underlying risks. For example, a low regulatory leverage limit for a bank imposed by OSFI may reflect an underlying risk in the bank's operations. Indeed, OSFI considers a range of factors, such as operating and management experience, strength of parent institution, earnings, diversification of assets, type of assets, and appetite for risk, when setting a regulatory leverage limit for individual institutions.[25] In the following section, we examine these trends by analyzing the ratios and compositions of the balance sheets of the banks in our sample, and discuss other regulatory and market developments.

Indicators of balance-sheet risks, by bank size and type

Table 2 shows the four measures of balance-sheet risks according to bank size and charter type, and by decade. Leverage ratios tend to be positively correlated with bank size. Among the non-Big Six financial institutions, domestic banks have the highest leverage, followed by foreign subsidiaries and trust and loan companies. All non-Big Six institutions show declining trends in leverage, which is consistent with the evolution shown in **Chart 1a**. The decline appears to be the largest for small banks, moving from 10.3 over the 1983–90 period to 1.8 after 2000, following the introduction of

◀ *All non-Big Six institutions show declining trends in leverage, while the Big Six banks maintained relatively higher leverage than that of their smaller peers*

Table 2: Indicators of balance-sheet risks at Canadian financial institutions, by bank size and charter type

		Non-Big Six banks					
	Big Six banks	Large	Medium	Small	Foreign subsidiary	Other domestic bank	Trust and loan company[a]
Leverage ratios							
1983–90	17.3	18.2	15.4	10.3	15.0	16.7	-
1991–2000	14.7	13.3	10.2	6.9	10.0	14.6	9.8
2001–11	16.6	11.7	8.8	1.8	8.0	9.9	4.5
Capital ratios[b] (%)							
1994–2000	7.1	8.5	13.1	22.9	9.9	9.3	22.2
2001–11	9.3	11.3	17.2	58.7	15.2	12.0	30.4
Asset-liquidity ratios (%)							
1983–90	16.0	16.2	25.4	26.0	23.0	9.7	-
1991–2000	15.9	18.8	14.8	20.5	18.7	12.6	11.8
2001–11	13.4	14.6	12.6	47.0	18.5	11.3	27.8
Funding ratios (%)							
1983–90	46.9	70.6	75.1	66.1	72.5	31.2	-
1991–2000	44.3	65.5	63.7	30.3	68.9	17.3	0.4
2001–11	46.4	30.3	11.1	0.2	38.3	9.7	0.0

a. Data on trust and loan companies date from 1996.
b. Data on regulatory capital ratios date from 1994.
Note: Numbers represent an average of monthly medians in each period.
Source: Office of the Superintendent of Financial Institutions Canada

25 See OSFI guidelines on capital adequacy requirements at <http://www.osfi-bsif.gc.ca/osfi/index_e.aspx?DetailID=527>.

bank-specific regulatory limits on leverage. In contrast, the Big Six banks maintained relatively higher leverage than that of their smaller peers throughout the sample period.[26]

Trends for capital ratios are consistent with those for leverage ratios

Trends for capital ratios are consistent with those for leverage ratios. Non-Big Six financial institutions have higher capital ratios, and small institutions (mostly trust and loan companies) show large increases in capital over time. This likely contributed to the observed spikes at the 75th percentile of the distribution of capital during the 2000s, as shown in **Chart 1b**. These observations point to increasing heterogeneity in capital ratios across institutions in Canada;[27] however, this trend is not observed everywhere (see **Box 2** for a comparison of Canada and the United States).

The composition of balance sheets of various financial institutions (**Chart 2**) helps us to understand how these trends are realized.[28] For many types of financial institutions, particularly small banks, capital ratios increased, owing to a rise in both capital (e.g., equity) and the percentage of assets considered to be low risk (e.g., cash, mortgage loans and public securities). Trust and loan companies are a notable exception: the decrease in the amount of lower-risk assets they held (driven mainly by a decline in mortgage loans) implies that their capital ratios increased primarily because they held more capital.

Many historical events may have influenced these observed changes to the balance sheets. For example, the loss of small banks from the sample, owing to failures in the 1980s and 1990s, may have left only less-leveraged and better-capitalized institutions in the sector.[29] Similarly, the acquisition of the largest trust and loan companies by the Big Six banks during the mid- to late 1990s may have resulted in the trust and loan company subgroup comprising only small and specialized institutions with riskier assets but more capital. In addition, the growing popularity of mortgage-loan securitization in the late 1990s, following the introduction of the Canada Mortgage Bonds Program, raised the percentage of mortgage loans on bank balance sheets, especially among large and medium-sized financial institutions.[30]

High asset-liquidity ratios during the 1980s (**Chart 1c**) were driven, in part, by medium-sized banks, many of them foreign subsidiaries, as shown in **Table 2**. In contrast, the high ratios in the 2000s were driven by small banks, particularly trust and loan companies. An increase in holdings of cash and public securities (i.e., highly liquid assets) among small banks in the 2000s is evident in **Chart 2**, an observation that is consistent with increasing asset-liquidity ratios.

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26 The interaction of leverage dynamics and the use of market-based funding was seen as a potential amplification mechanism of adverse shocks during the financial crisis (Adrian and Shin 2010). Research at the Bank of Canada also investigates this channel using Canadian data (see **Box 1**).

27 In 2008, the Basel II framework on capital requirements was implemented, allowing OSFI-approved institutions to adopt the internal ratings-based (IRB) approach to determining risk weights. In contrast to the standardized method, the IRB approach can lead to lower assessed risk weights. Since only the Big Six banks have adopted this approach, the recent divergence in capital ratios may, in part, reflect this difference in risk-assessment practices. In addition, bank-specific limits on leverage would also have contributed to increasing heterogeneity in capital ratios.

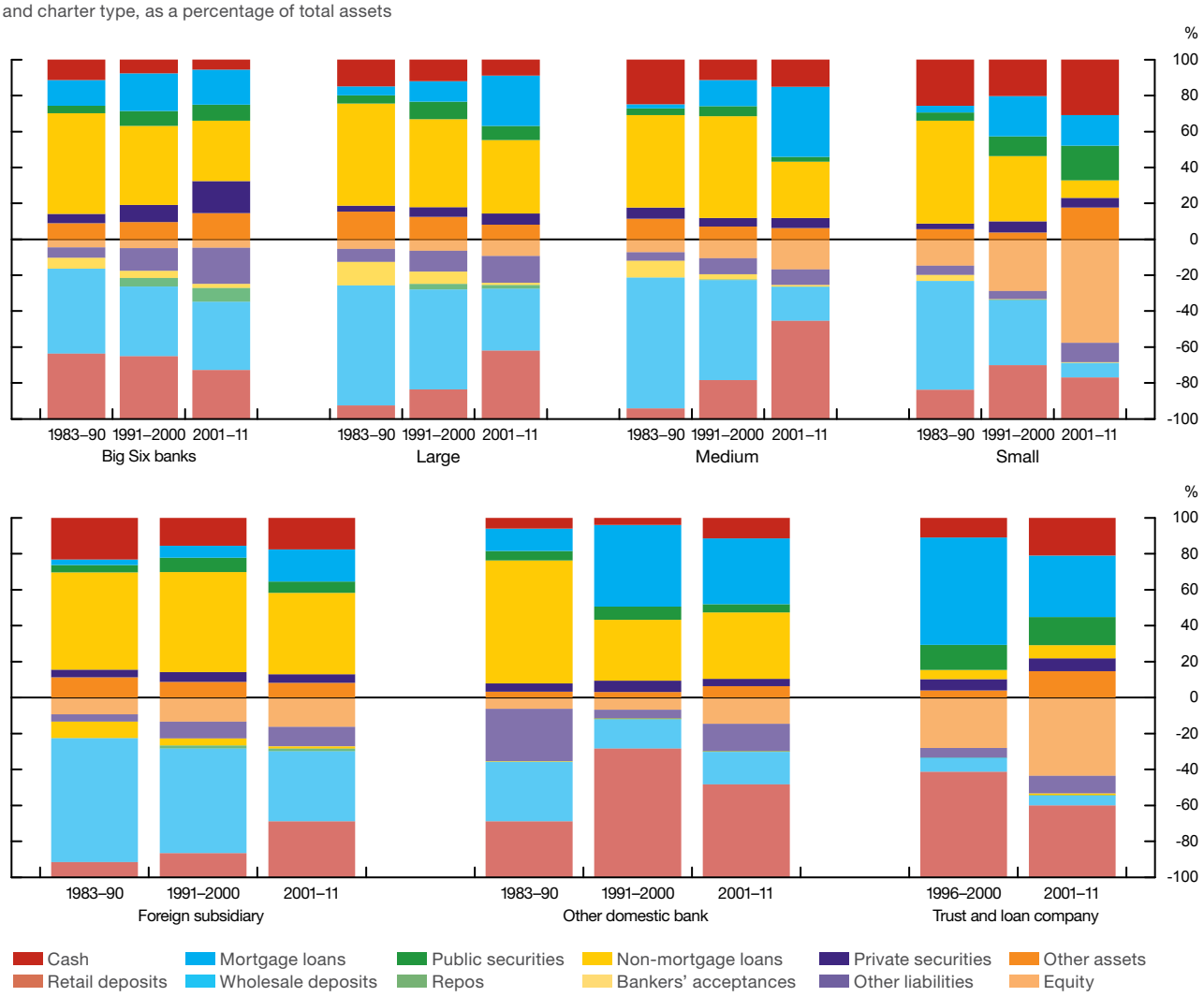
28 A disaggregation of the Big Six banks reveals that their balance sheets are of a fairly similar composition, also implying their similarity in resilience to different types of shocks. Therefore, for the purposes of this article, analyses focus on the Big Six as a group.

29 See Canada Deposit Insurance Corporation, "History of Member Institution Failures" at <http://www.cdic.ca/e/insuredWhere/history_failures.html>.

30 Increasing demand for mortgage loans caused by demographic shifts and lower down-payment requirements has also played a role. See Chen et al. (forthcoming) for more details.

Chart 2: Composition of balance sheets of various financial institutions

By size and charter type, as a percentage of total assets



Note: Data on trust and loan companies date from 1996. Percentages are the averages across institutions and over time.

Source: Office of the Superintendent of Financial Institutions Canada

Last observation: August 2011

Finally, the funding ratios of the Big Six banks have remained stable since the early 1980s, moving between approximately 44 per cent and 47 per cent (**Table 2**), suggesting that they had in place the liquidity-management processes required by OSFI's 1995 guidelines well before the guidelines were established. Small and medium-sized banks significantly reduced their use of market-based funding over time, from more than two-thirds of their assets in the 1980s to around 10 per cent or less in the 2000s. While use of market-based funding fell dramatically across all categories of the non-Big Six group, the relatively high, continuous use of this funding source by foreign subsidiaries may have been influenced by their access to global funding markets.

◀ *The funding ratios of the Big Six banks have remained stable since the early 1980s, while small and medium-sized banks significantly reduced their use of market-based funding over time*

Box 1

Leverage and Wholesale Funding

Since wholesale-funding markets are sensitive to financial and economic conditions, the degree to which a bank relies on such funding can influence its activities. Research at the Bank of Canada (Damar, Meh and Terajima 2010) examines the interaction between a bank's reliance on wholesale funding and leverage to better understand how Canadian financial institutions manage their leverage and whether changes in leverage are positively correlated with changes in the size of their balance sheets (i.e., whether leverage is procyclical). A positive correlation between leverage and asset size implies that financial institutions use non-equity funds (i.e., debt) to finance new assets.

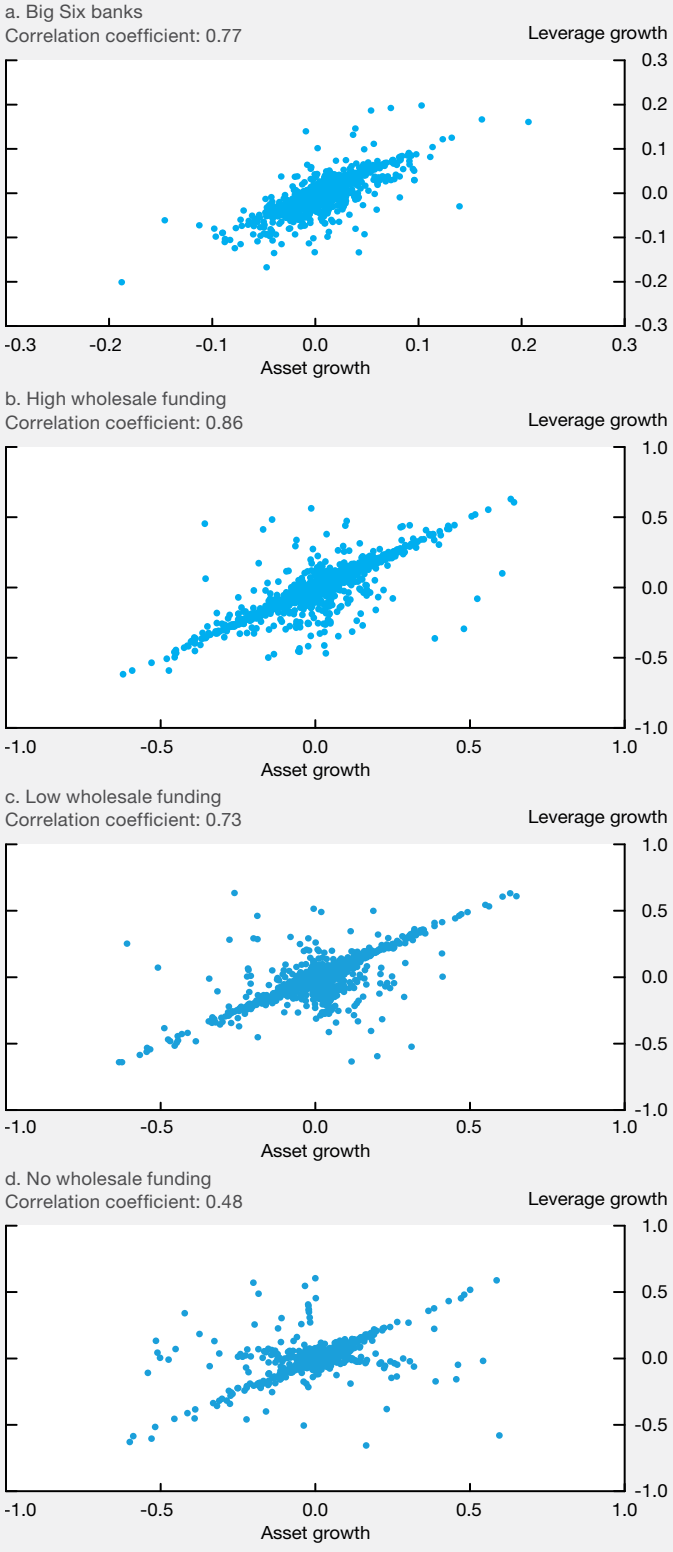
This phenomenon was first described by Adrian and Shin (2008; 2010; 2012), who found a strong positive correlation between leverage and balance-sheet size in U.S. investment banks. They argue that increases in the prices of certain assets (mostly securities) can increase both leverage and balance-sheet size. Since asset prices are more likely to increase during booms, bank balance sheets tend to expand, owing to a rise in marked-to-market bank asset values and higher loan demand. At the same time, perceived risk tends to fall, leading to lower interest rates for bank funding. Banks issue more debt, and thus leverage increases, thereby exhibiting procyclicality.

Using Canadian data, Damar, Meh and Terajima (2010) estimate a series of both cross-sectional and time-series regressions. They find a strong positive correlation between asset growth and leverage growth for all banks. In addition, their findings show that leverage is relatively more procyclical for institutions that rely on wholesale funding. As illustrated in **Chart 1-A**, measured correlations using monthly data decline from 0.86 for institutions with high wholesale funding to 0.73 for those with low wholesale funding, and finally to 0.48 for those with none.[1] The correlation for the Big Six banks is 0.77, which does not stand out among other banks. The degree of correlation between asset growth and leverage growth is therefore closely related to the funding source and is present among more financial institutions than just the largest Canadian banks.

Damar, Meh and Terajima (2010) conclude that, since wholesale funding is cheaper and can be obtained more readily than retail deposits, a bank with access to wholesale-funding markets can easily purchase new assets with these funds, leading to procyclicality in leverage. Their analysis also establishes that highly liquid wholesale-funding markets make it even easier for Canadian banks to purchase assets using wholesale funds, strengthening the positive correlation between assets and leverage.

1 Qualitatively similar results are observed using annual data. The correlation measures for the Big Six, as well as non-Big Six institutions with high, low and no wholesale funding are 0.37, 0.66, 0.54 and 0.47, respectively.

Chart 1-A: Monthly change in assets and leverage in Canada, 1994–2009



Source: Office of the Superintendent of Financial Institutions Canada

Box 2

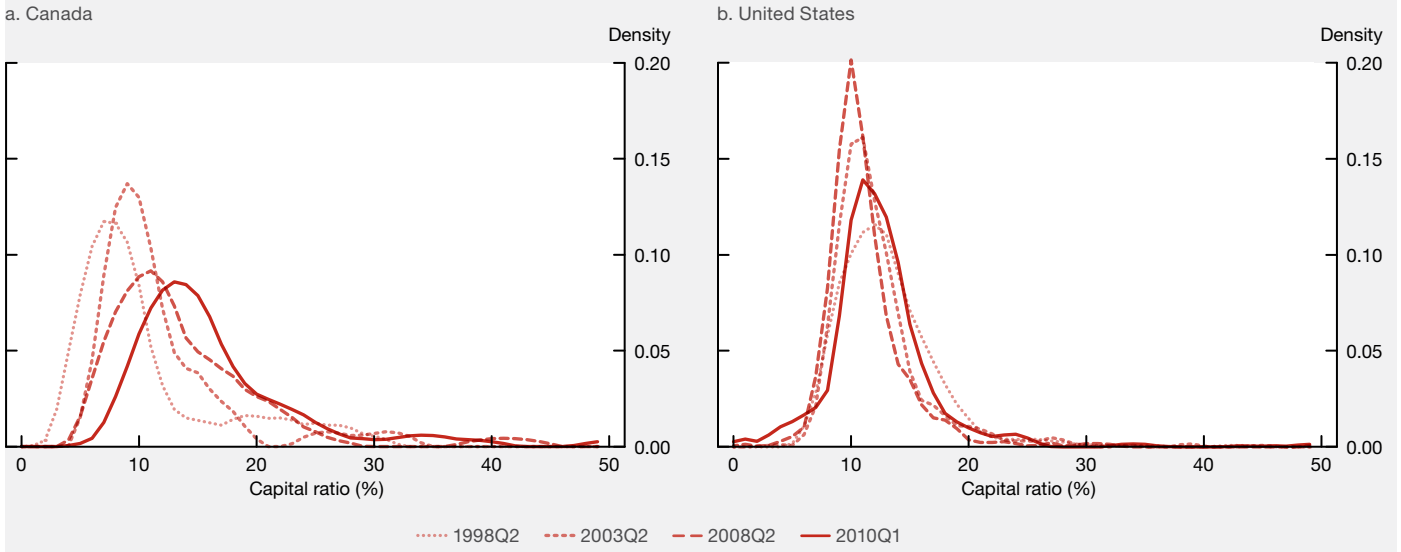
A Comparison of Bank Capital Ratios in Canada and the United States

Capital ratios among Canadian banks have become more heterogeneous over time; however, this trend has not been observed in the United States.

Chart 2-A shows the estimated probability density (i.e., kernel density estimations) of capital ratios of financial institutions in Canada and the United States. In Canada, an increasing mode and fatter right tail (i.e., the number of financial institutions with higher capital ratios) have been observed over time, while in the United States, the distribution has remained relatively unchanged and is centred around its mode.[1] As noted, the increasing amounts of higher capital holdings (and hence fatter right tails) have been driven primarily by the non-Big Six Canadian financial institutions. The country's bank-specific regulatory approach contributes, in part, to this heterogeneity.

1 Chart 1b in the main text shows that the distributional shift to higher capital ratios in Canada is also slightly supported by the Big Six banks, suggesting the systemic importance of these changes.

Chart 2-A: Estimated probability density of capital ratios, Canada and the United States



Sources: Office of the Superintendent of Financial Institutions Canada and the Federal Reserve Bank of Chicago

Last observation: 2010Q1

Concluding Remarks

This article analyzes the balance-sheet ratios of Canadian financial institutions. Overall, various measures of risk have decreased over the past three decades for most non-Big Six institutions and have remained relatively unchanged for the Big Six banks. We find that smaller institutions, particularly trust and loan companies, generally have lower leverage and higher capital ratios than other types of financial institutions, including the Big Six banks. They also have larger holdings of liquid assets and face lower funding risk compared with other financial institutions. The observed overall decline and increased heterogeneity in risk (as measured by divergent trends in the leverage, capital and asset-liquidity ratios) followed certain regulatory changes, such as the introduction of liquidity guidelines on funding in 1995 (which preceded a sharp decline in, and more dispersion of, funding ratios among non-Big Six institutions) and the implementation of bank-specific leverage requirements in 2000 (which preceded a divergence in leverage ratios between the Big Six and non-Big Six institutions). This suggests that regulatory changes had significant and heterogeneous impacts on the management of balance sheets by financial institutions, resulting in

the increased resilience of the banking system. While market discipline may have also played a role, more research is needed to identify changes in the degree of market discipline in the Canadian banking sector.

Given the observed variation in behaviour among Canadian financial institutions, continued analysis of different types of institutions can enable a more comprehensive assessment of financial stability. Understanding the different risks faced by various types of financial institutions improves the framework that the Bank of Canada uses to monitor developments of potential risks in the banking sector.

Appendix 1

Table A-1: Active financial institutions, by bank size and charter type, in August 2011

Big Six banks		
Bank of Montreal	Canadian Imperial Bank of Commerce	Royal Bank of Canada
Bank of Nova Scotia (The)	National Bank of Canada	Toronto-Dominion Bank (The)

Non-Big Six banks			
	Foreign subsidiary	Other domestic bank	Trust and loan company
Large	AMEX Bank of Canada Bank of Tokyo-Mitsubishi UJF (Canada) BNP Paribas (Canada) Citibank Canada HSBC Bank Canada ICICI Bank Canada ING Bank of Canada MBNA Canada Bank	Bridgewater Bank Canadian Tire Bank Canadian Western Bank Laurentian Bank of Canada Manulife Bank of Canada	AGF Trust Company Equitable Trust Company (The) Home Trust Company MCAN Mortgage Corporation Peoples Trust Company RBC Dexia Investor Services Trust ResMor Trust Company
Medium	Bank of China (Canada) Industrial and Commercial Bank of China (Canada) Korea Exchange Bank of Canada Mega International Commercial Bank (Canada) Shinhan Bank Canada Société Générale (Canada) State Bank of India (Canada) Sumitomo Mitsui Banking Corporation of Canada UBS Bank (Canada)	Bank West First Nations Bank of Canada General Bank of Canada HomEquity Bank Pacific & Western Bank of Canada President's Choice Financial	Community Trust Company Effort Trust Company (The) League Savings and Mortgage Company M.R.S. Trust Company Peace Hills Trust Company
Small	CTC Bank of Canada Habib Canadian Bank	Alterna Bank Citizens Bank of Canada DirectCash Bank Jameson Bank	BNY Trust Company of Canada Caledon Trust Company Computershare Trust Company of Canada Concentra Trust Equity Financial Trust Company Fiduciary Trust Canada First Data Loan Company, Canada Industrial Alliance Trust Inc. Investors Group Trust Co. Ltd. Legacy Private Trust Oak Trust Standard Life Trust Company State Street Trust Company Canada Valiant Trust Company

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