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June 5, 2019

Approved By
Western Hemisphere Department

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ASSESSING HOUSE PRICES IN CANADA[1]

This chapter uses a "borrowing capacity" approach to evaluate Canadian house prices. The approach uses household income, interest rates, and leverage requirements to determine households' borrowing capacity. The results show that house prices respond rapidly to households' ability to borrow, suggesting that policy measures that facilitate greater access to credit would likely increase house prices and household debt. In most Canadian metropolitan areas, house prices are broadly aligned with households' borrowing capacity. However, house prices are significantly higher than "attainable" levels in Hamilton, Toronto, and Vancouver.

A. Introduction

1. House prices in eleven Canadian census metropolitan areas (CMAs) are assessed using a static borrowing-capacity (SBC) approach.[2] The approach uses household income, mortgage interest rates, and leverage requirements to determine households' borrowing capacity. Estimates of "attainable" house prices are compared with actual prices to determine whether they are aligned, where it is implicitly assumed that house prices ultimately reflect households' ability to borrow.

2. Why the SBC approach? While other approaches are available, ranging from simple detrended price-to-income indicators and regression analysis to more complicated structural dynamic economic models, the SBC approach has several attractive features:

- *The approach is intuitive, simple to implement, and available in real time.* It incorporates few variables and a handful of structural parameters. Unlike normalized price-to-income ratios, it has clear units of interpretation. Standard regression analysis is often used to estimate measures of house price fundamentals, but these measures impose the restriction that house prices are in line with fundamentals on average over the sample—a strong assumption, especially in short samples. Unlike time-series regression models, the SBC approach also does not require historical data.

- *The approach can readily be used to assess the impact of monetary and macroprudential policy on borrowing capacity.* Because interest rates explicitly enter the model, the impact of monetary policy can easily be assessed. The impact of macroprudential policy can also be evaluated through changes to the debt-service-to-income (DSTI) ratio, the loan-to-value (LTV) ratio, and the loan-to-income (LTI) ratio.

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[1] Prepared by Michal Andrle (RES). The author would like to thank Cheng Hoon Lim, Ivo Krznar, Troy Matheson (all WHD), and Ben Hunt (RES) for comments and Miroslav-Kleki Plašil (Czech National Bank) for collaboration on the house-prices assessment methods. Dan Pan provided excellent research assistance.

[2] See Andrle and Plašil (2019).

- *The approach appears to match the observed behavior of Canadian households.* According to the 2018 Canadian Mortgage and Housing Corporation's (CMHC) Mortgage Survey[3], 85 percent of first-time buyers spent as much as they could afford when purchasing their home.

3. The chapter proceeds as follows. Section B outlines the SBC approach and its implications for households' borrowing capacity. Section C describes the data and assumptions used in the analysis and sections D and E discuss the results and other findings. Section F concludes with a summary of the findings and a policy discussion.

B. Static Borrowing-Capacity Approach

Model

4. The static borrowing-capacity approach (SBC) determines how much housing a household can afford given its income, the prevailing mortgage rate, and leverage requirements.[4] A household can allocate a portion α of its income Y_t (at origination) to service its mortgage payment, A_t:

$$A_t = \alpha Y_t. \tag{1}$$

Given the monthly mortgage payment, A_t, the mortgage interest rate, i_t^m (per month), and the maturity of the mortgage loan in months, N_t^m, the bank determines the mortgage loan amount available, L_t, using standard mortgage-contract calculations:

$$L_t = \left[\frac{(1+i_t^m)^{\wedge}N_t^m - 1}{i_t^m(1+i_t^m)^{\wedge}N_t^m}\right] \times \alpha Y_t \equiv f(i_t^m, N_t^m) \times \alpha Y_t. \tag{2}$$

Household's mortgage loan, L_t, and its savings for the down payment, D_t, add up to the "housing", PH_t, it can attain:

$$PH_t \equiv P_t^h H_t = L_t + D_t, \tag{3}$$

where the value of the house is a combination of price per quantity of housing and the quantity of housing.

5. Assumptions about each household's down payment are crucial for estimates of "attainable" house prices. One possible assumption is to consider the down payment as a constant share of income, or household wealth. Another option is to let households choose their down payment as implied by a stable loan-to-value (LTV) ratio (for example, a down payment of 20

[3] https://www.cmhc-schl.gc.ca/en/data-and-research/consumer-surveys/mortgage-consumer-survey/homebuyers-data

[4] Andrle and Plašil (2019) also develop the concept of "dynamic borrowing capacity", where the future path of income and interest rates are reflected in household capacity to borrow, with emphasis on the financial stability.

percent of the property price). Given that a stable LTV is observed for the marginal buyer, it is used in the baseline model, resulting in a closed-form solution for attainable housing:

$$PH_t = \frac{1}{LTV} f(i_t^m, N_t^m) \times \alpha Y_t. \quad (4)$$

Model Implications

6. The house pricing formula (4) is the key relationship used to assess house prices.[5] It estimates "attainable" house prices, conditioned on the households' borrowing-capacity. The pricing formula has several important implications, discussed below.

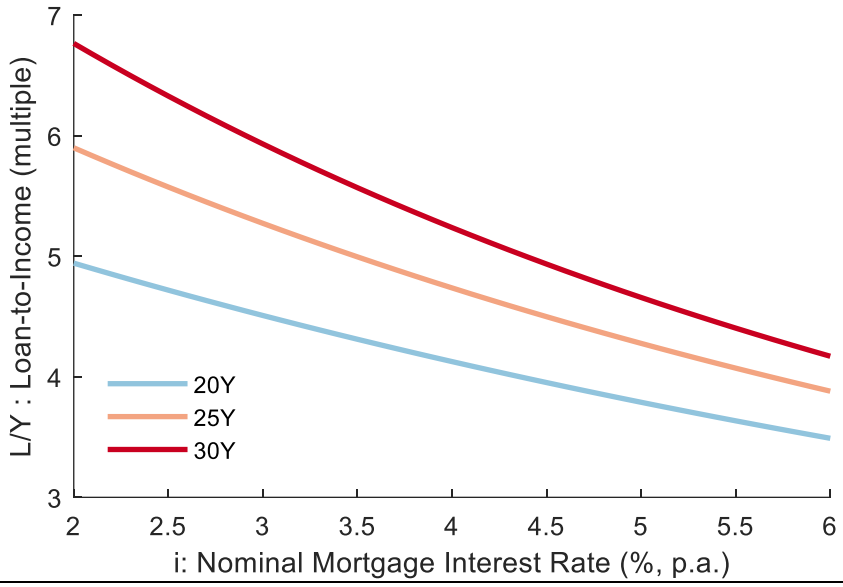
- *Nominal house prices grow in line with nominal income in the long run.* With constant loan-to-value ratios, debt-service-to-income ratios, and mortgage interest rates, (4) implies that house prices will grow with households' income, $P\dot{H}_t = \dot{Y}_t$.

- *A permanent decrease in mortgage rates will permanently increase debt-to-income ratios.* If a household keeps its debt-service-to-income ratio, α, constant (at origination), a permanent decline in nominal interest rates will lead to a permanently higher loan-to-income ratio. This follows from (2), which shows that the loan-to-income ratio, L_t/Y_t, is a function of DSTI (α), the interest rate, and the amortization period: $L_t/Y_t = f(i_t^m, N_t^m) \times \alpha$. Lower interest rates quickly increase LTI ratios for new home-owners and gradually increase overall household debt relative to income. Figure 1 demonstrates the non-linear relationship between LTI ratios and interest rates for different maturities.

- *A permanent decrease in mortgage rates will permanently increase price-to-income ratios.* Often, the price-to-income ratio is used to assess if house prices are overvalued, under an implicit or explicit assumption that the ratio is mean-reverting. Under the SBC hypothesis, however, it is the DSTI that is considered stable, and permanent changes in interest rates also permanently change the price-to-income ratio: from (4) it follows that $PH_t/Y_t = f(i_t^m, N_t^m) \times \alpha/LTV$. The fact that price-to-income ratio depends on the nominal level of the mortgage rate, which has been declining, may limit the usefulness of comparing price-to-income ratios to historical levels for house price assessments.

[5] The formula is labeled as "pricing", rather than "valuation" due to differences between the static borrowing-capacity approach and the investment approach, see Andrle and Plašil (2019) for more details.

Figure 1. Canada: Effect on Interest Rates on Loan-to-Income Multiple



- *A decline in mortgage rates increases the down payment as a share of income.* This is because lower mortgage rates increase the price-to-income ratio when the LTV is assumed to be constant, increasing the time required to save for the down payment. Thus, declining interest rates worsen housing affordability for many households.[6]

- *It is the flow of credit, not the stock of credit, that is the relevant variable for house price assessments.* The borrowing-capacity model makes it clear why focusing on the newly-issued credit for the marginal buyers is relevant for house prices. The stock of mortgage credit is a combination of new and historical vintages of credit, complicating the interpretation of the credit stance for assessing house prices, and distorting real-time information about credit developments.[7]

7. In the long term, house price deviations from fundamentals will adjust through changes in price, changes in borrowing capacity, or both. Deviations from fundamentals can be caused by supply-side constraints and a number of other factors (e.g. speculation). The bigger the deviation, the higher the risk of a sharp correction in prices. This is because house prices can adjust more quickly than housing supply and income.

[6] Should one assume that the down payment is, for simplicity, a constant fraction of income $D_t = \kappa Y_t$, the resulting estimate of the price of housing would be $PH_t = [f(i_t^m) \times \alpha + \kappa]Y_t$. Under this assumption, the estimated house price would be less elastic with respect to the mortgage rate and the estimated α would differ. Also, assuming each household saves a portion of its current income for *R* years results in a similar expression. Loan-to-income ceilings would have even larger effect, with $PH_t = LTI_{max} \times Y_t + D_t$ when LTI limit is binding. With binding LTI limit, a reduction in interest rate would lead to decline in DSTI.

[7] Adalid and Falagiarda (2018) illustrate in detail the delayed effects of new loan origination and loan repayment on the stock of credit.

C. Data and Assumptions

8. The analysis uses data from a variety of sources. Detailed descriptions and data references can be found in the appendix.

9. Median-income households are assumed to take on mortgage loans for 25 years with interest rates fixed for 5-year intervals. Correspondingly, "conventional mortgage lending rate" for the five-year term from CMHC is used in all computations. Unless otherwise noted, the baseline loan-to-value (LTV) ratio is 80 percent. The fixed LTV affects estimated house price levels but not their dynamics. Median-income households are assumed to be the prospective buyers of median-priced housing. House prices are sourced from Real Property Solutions and Teranet, expressed in nominal Canadian dollars.

10. The share of income allocated to DSTI at origination, α, is a crucial assumption. An obvious option is to set α to an identical value across all CMAs, say 30 percent of after-tax median household income. This choice, however, ignores the fact that there may be good reasons for α to vary across regions. Even under an assumption of perfect regional mobility and households equalizing utility across regions, outlays on housing as a share of income can differ, as indicated by the literature on spatial equilibrium (see Roback, 1982, for example). Regions differ in their amenities, productivity, local taxes, price of services, etc. But even with the same amenities, the share of income allocated for housing expenses may vary with income. For instance, earning C$100,000 a year and paying 50 percent of your income on housing may still be preferable to earning C$70,000, allocating "only" 30 percent of your income to housing, and having lower "ex-housing residual income".[8]

11. For transparency, both the region-specific housing share of income, α, and the common share are used in the analysis. To estimate the region-specific $\alpha_{i,t}$, SBC formula (4) is used with available income, mortgage rate, and observed regional house prices. An average for 2004—2006 is then used for the whole sample of 2000Q1—2018Q4. The normalization aims to avoid the sample around the dot-com and financial crisis episodes.

D. Results

12. House prices in most CMAs can be explained by households' borrowing capacity. Figure 2 displays observed house prices and the estimate of "attainable" house prices using the SBC.

[8] This would be a natural result with non-homothetic preferences. For instance, with Stone-Geary utility over housing, H, and other goods, C, a minimum necessary consumption of other goods, C_min, the share of housing services on total income will increase with the income, Ph*H = alpha * (Y – Pc*C_min). It will be a constant share of the "after-necessities residual income", (Y – Pc*Qc).

These baseline calculations assume region-specific DSTI ratios, $\alpha_{i,t}$. From 2000 to 2018, house prices in most CMAs grew in line with rising nominal incomes and declining mortgage interest rates.[9]

13. However, house prices in Hamilton, Toronto, and Vancouver are significantly higher than estimated attainable levels. The pricing gaps in 2018 are around 50 percent for Toronto and Vancouver, and almost 60 percent for Hamilton.[10] Additional factors beyond borrowing capacity are needed to explain the evolution of house prices in these CMAs, such as supply-side factors.[11] Such large pricing gaps are not without precedent in Canada, with developments in Calgary and Edmonton over 2006 to 2012 being examples.

14. Declining mortgage rates have contributed significantly to rising house prices. The SBC formula (4) can be decomposed into contributions from income and interest rates. Figure 3 illustrates such a decomposition for Edmonton. The contributions from interest rates reflect changes in mortgage rates since 2001Q1. In 2017 when mortgage rates were at their lowest point, they could have added C$100,000 to the median house price of C$400,000. On the other hand, the recent increase in mortgage rates has put downward pressure on house prices.

15. The experience of Calgary and Edmonton metropolitan areas are examples of a "soft landing". In Edmonton, the median house price exceeded the attainable level by 60 percent at its peak in 2007Q3 (figure 3). By 2012Q1, the median price became more aligned with fundamentals due to a moderate decline in house prices, income growth, and sizable declines in mortgage interest rates. Their experience suggest that market exuberance and supply constraints may widen the price deviation from fundamentals only temporarily. In this context, Calgary and Edmonton offer credence to the magnitude of the price deviations in Hamilton, Toronto, and Vancouver and reassurance that the gaps will eventually close. However, the adjustment path will be different because such a large decline in mortgage rates is unlikely in the future.

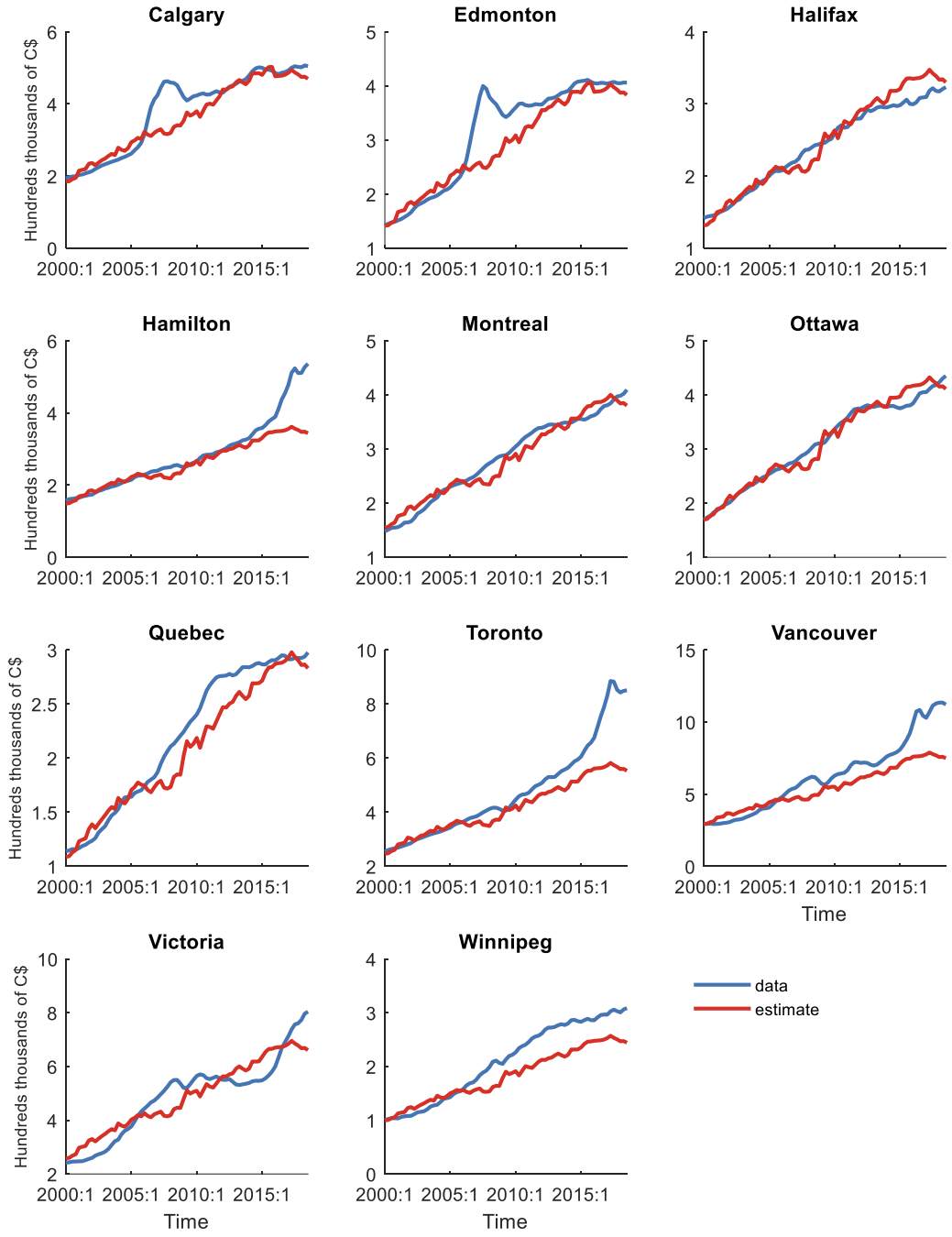
16. Real estate transactions occurring at very elevated prices suggest a rising share of purchases by households with high income. For example, in 2016, households in Toronto with 1.7 times median income could comfortably afford to devote 30 percent of their income to mortgage debt servicing. There were at least 20 percent of such households in the Toronto CMA, but this share has shrunk as house prices have continued to climb since 2016. As a result, housing affordability has deteriorated.

[9] The attainable house prices estimate with uniform 30 percent DSTI assumption are in Figure 2 in the Appendix.

[10] Hamilton house prices seemed aligned with borrowing capacity of households until very recently. The recent misalignment likely reflects the commuting distance to Toronto, and a tight housing market in Toronto CMA.

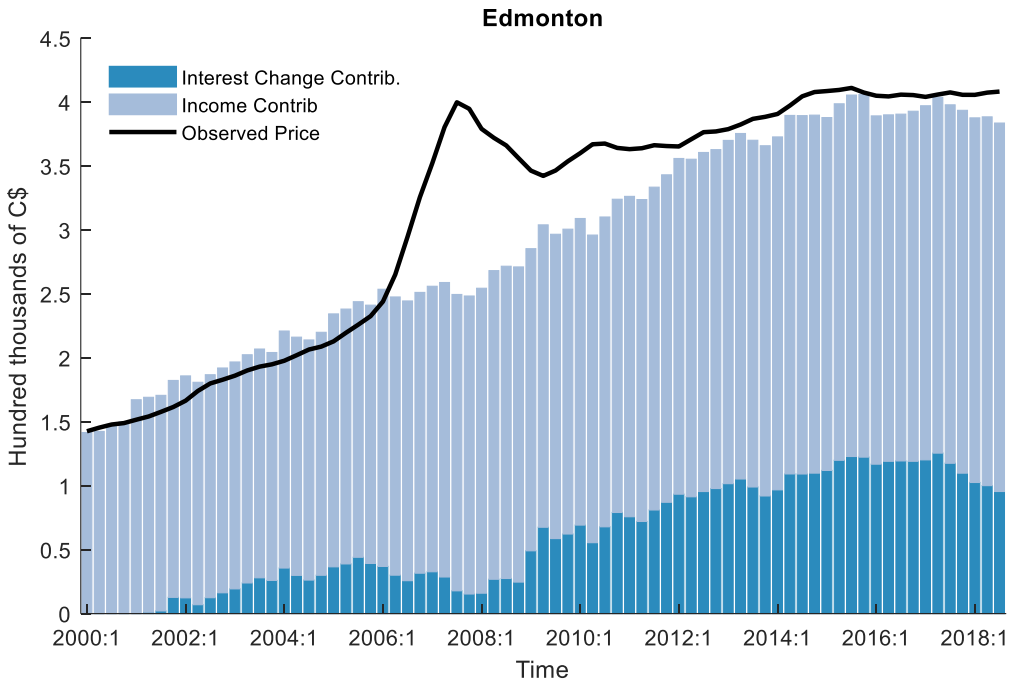
[11] The analysis of supply-side factors in Canada is detailed in the 2018 Staff Report (IMF 2018).

Figure 2. Canada: Observed Aggregate House Prices in Canada vs. "Attainable" House Prices



Source: Statistics Canada, CMHC, Haver Analytics, Real Property Solutions, LLC., Teranet, own calculations

Figure 3. Canada: Edmonton: Contribution of Interest and Income Using the SBC Model



Source: Statistics Canada, CMHC, Haver Analytics, Real Property Solutions, LLC., Teranet, own calculations

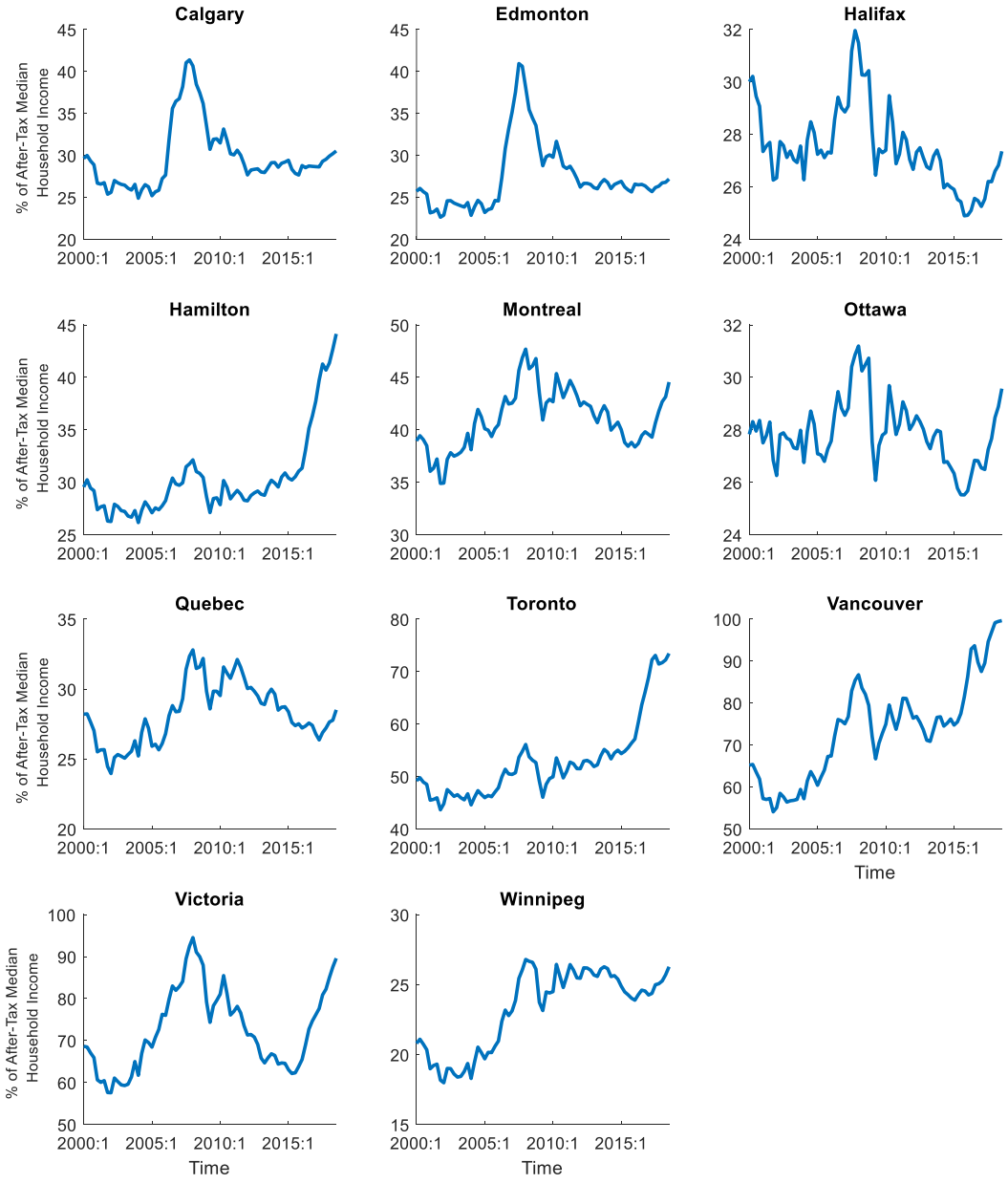
E. Other Findings

17. There are sizable differences in DSTI ratios across CMAs. Figure 4 displays the estimates for all the CMAs.[12] The share of income needed to service the mortgage loan to afford housing at a prevailing price depends on the definition of income (household income vs. family income) but the relative differences are stable. In Toronto, Vancouver, or Victoria median-income households would need to devote more than 50 percent of their after-tax income to housing. The share is considerably lower in other CMAs, averaging around 30 percent. In Hamilton, the share was around 30 percent up until 2016, and then a sharp increase in house prices pushed the required DSTI for the median household towards 45 percent.

18. As mortgage rates increase, house prices need not decline if income growth compensates for rising interest costs. If mortgage interest rates continue to increase, they will put house prices under pressure. Without additional policy measures, income growth will be the decisive factor for keeping attainable house prices stable or even increasing in the future.

[12] Figure 2 in the Appendix presents the estimated "attainable" house prices from the SBC model under the common assumption of 30 % of after-tax median household income going to mortgage payments (at origination).

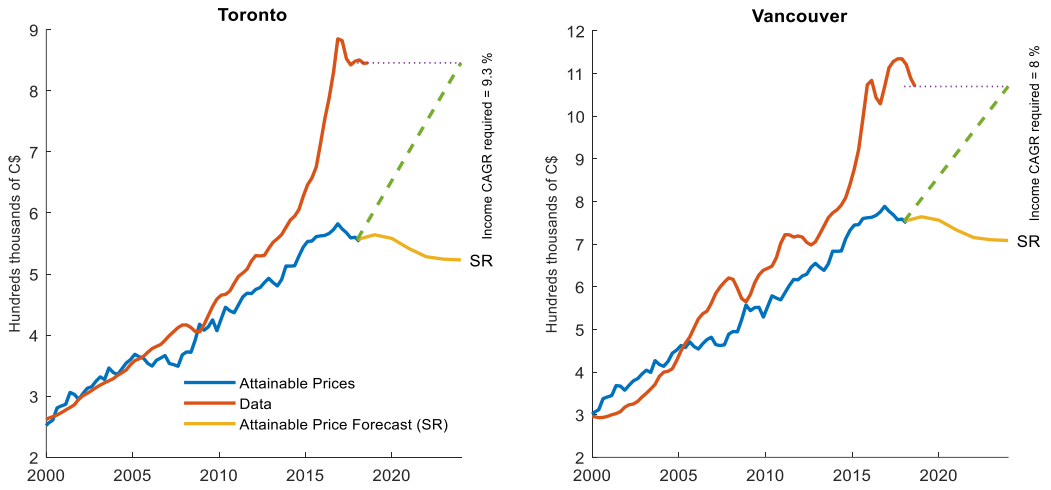
Figure 4. Canada: Implied Share of Debt-Service to After-Tax Median Household Income



Source: Statistics Canada, CMHC, Haver Analytics, Real Property Solutions, LLC., Teranet, own calculations

19. Staff Report (SR) projections for income growth and interest rates suggest that attainable house prices could decline slightly over the next five years. Expected income growth will support attainable prices, while an expected increase in interest rates will reduce attainable prices. As shown in figure 5, the balance of these two offsetting effects suggests a slight decline in attainable prices over the forecast horizon. Assuming staff's interest rate projections, levels of income growth required to raise attainable prices enough to close pricing gaps over the next 5 years in Toronto and Vancouver are very high (cumulative annual growth rates CAGRs needed are 9.3 and 8 percent, respectively). In other CMAs, with house prices better aligned with estimated attainable prices, closing pricing gaps through borrowing capacity alone would require income CAGRs below 3 percent. The results suggest that without very strong income growth in Hamilton, Toronto, and Vancouver there is a risk of further price corrections in these markets.[13]

Figure 5. Canada: Closing the Pricing Gap with Stronger Income Growth



Source: Statistics Canada, CMHC, Haver Analytics, Real Property Solutions, LLC., Teranet, staff calculations

F. Summary and Policy Implications

20. House prices in most Canadian regions can be explained by economic fundamentals, but prices in Hamilton, Toronto, and Vancouver are currently well-above estimated attainable levels. Since 2000, house price developments in most metropolitan regions can be explained by robust income growth and a decline in mortgage interest rates. House prices have broadly increased in line with households' borrowing capacity. However, since 2015, prices in Hamilton, Toronto, and Vancouver have deviated significantly from fundamentals. By the end of 2018, pricing gaps stood at around 50 percent for Toronto and Vancouver, and almost 60 percent for Hamilton.

21. The overvaluations currently observed in Hamilton, Toronto, and Vancouver are not unprecedented. In 2006, house prices in Calgary and Edmonton increased sharply above estimates

[13] It is worthwhile noting here that exactly how house-price gaps ultimately adjust is highly uncertain, and can occur through changes in prices, changes in attainable prices, or some combination of both.

of borrowing capacity. Pricing gaps normalized by 2012 due to a combination of moderate declines in house prices, strong household income growth, and a decline in interest rates. Looking ahead, housing markets in Hamilton, Toronto, and Vancouver are not likely to benefit from such significant declines in interest rates. This suggests that without very strong income growth, there is a risk of further price corrections in these markets.

22. Nationwide increases in price-to-income ratios have significantly lowered housing affordability. Declines in mortgage rates have generally been rapidly priced in by housing markets, increasing price-to-income and loan-to-income ratios. With rising price-to-income ratios, down payments have become larger, increasing the time it takes to save for a house, and adversely impacting housing affordability. While housing affordability has deteriorated in all of the regions examined, the deterioration has been most marked in Hamilton, Toronto, and Vancouver.

23. If house prices rapidly reflect households' ability to borrow, even well-intentioned policies that improve access to credit are likely to increase house prices and adversely impact affordability. Policy measures that increase households' capacity to borrow—such as increasing the mortgage loan amortization period or subsidizing loans—will likely put additional upward pressure on prices. Indeed, for such measures to work, the supply of housing would need to be exceptionally (and unrealistically) elastic, even in the short run. As such, policy measures focused on increasing housing supply are needed to durably improve housing affordability over the long term.

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Appendix I. Data and Additional Results

A. Data Sources and Transformations

House Prices Data

1. Multiple data sources are used to analyze house prices in selected Census Metropolitan Areas (CMAs) in Canada, but the main resource is the Real Property Solutions, LLC, (RPS) database[1] with house prices in Canadian dollars. This database is at monthly frequency, available back to 2005M1, see RPS (2017) for details of the methodology of estimating the median house prices. The RPS dataset is extend as far back to 2000M1 using the dynamics of house price indices from the Teranet database. The RPS and Teranet database dynamics in the overlapping sample are similar, however, with the dollar values of the Teranet indices not available.

Income, Population, and Other Data

2. Income data for the assessment of house prices should match well the information about the dwelling concerned (aggregate, house, condo), its size, and the likely demographics demanding the dwelling. For the aggregates and houses, the analysis works with the pre-tax median income of a family for which annual estimates are available. To work with household median income, the levels of the family income are scaled to household income levels from the 2016 Consensus for each CMA. The annual numbers are interpolated to quarterly frequency in 2000—2016 and extrapolated to the end of 2018 using the disposable income dynamics for the province as an auxiliary series. The results are rather robust to use of alternative measures of household income.

3. The choice of the demand unit is mainly relevant to the level of income, less so for its dynamics. The median family income is higher than the median household income in Canada. The composition matters – in 2016 the median pre-tax income of a "couple family with or without children" was $89,610. This is 58 percent higher than the "all family units" income and higher than "lone-parent" families. The dynamics of median family income are converted to median "household" income using the income levels from 2016 Census.

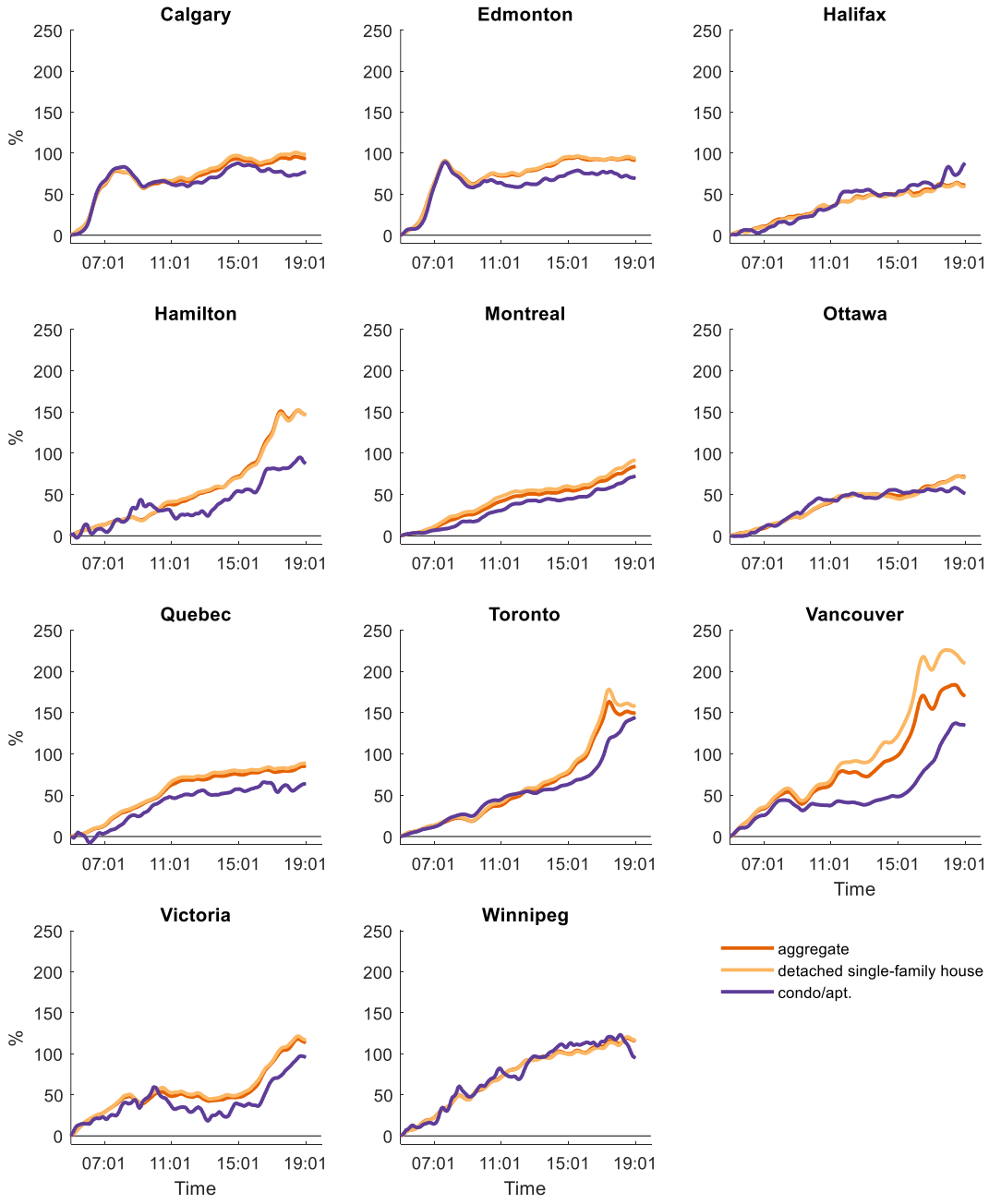
4. Population data are sourced from Statistics Canada via Haver Analytics database. For 2018, the annual series were extended by the monthly three-month averages of population

[1] RPS Real Property Solutions provided the database free of charge for this analysis. **Terms of Use and Disclaimer:** All rights reserved. Any reproduction or distribution with respect to the content of the RPS House Price Index is prohibited. The information provided herein is for informational purposes on matters of general interest, and is not intended to provide the basis for investment, financial, real estate, tax or other professional advice or services. The information is derived from sources believed reliable; however, no warranties or representations are being made with respect to the information, and RPS Real Property Solutions, along with its parent companies, subsidiaries and affiliates, disclaims all liability with respect to the accuracy of the information. The information is not a substitute for the advice of a qualified professional.

estimates from Labor Force Survey, via Haver Analytics. The average size of the household is based on 2016 Census (Statistics Canada, Census Profile).

B. Additional Results

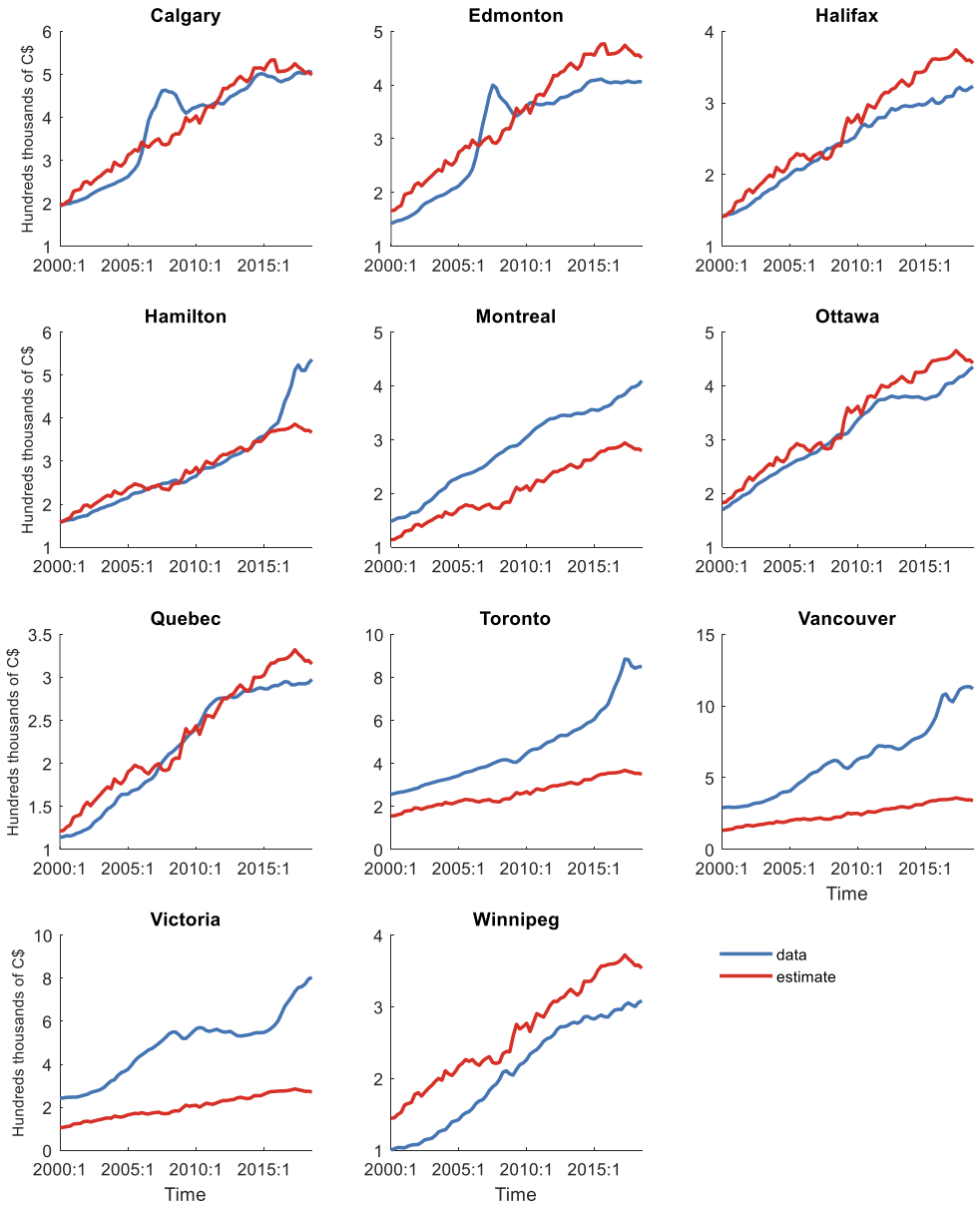
Figure 1. Canada: House Prices—Aggregate, Condos, and Single-Detached Family House



Note: Percent increase since May 2005.

Source: RPS-Real Property Solutions, LLC.

Figure 2. Canada: Attainable Prices Assuming Uniform DSTI =30 % of After-Tax Household Income



Source: RPS-Real Property Solutions, LLC., Tera Net, Statistics Canada

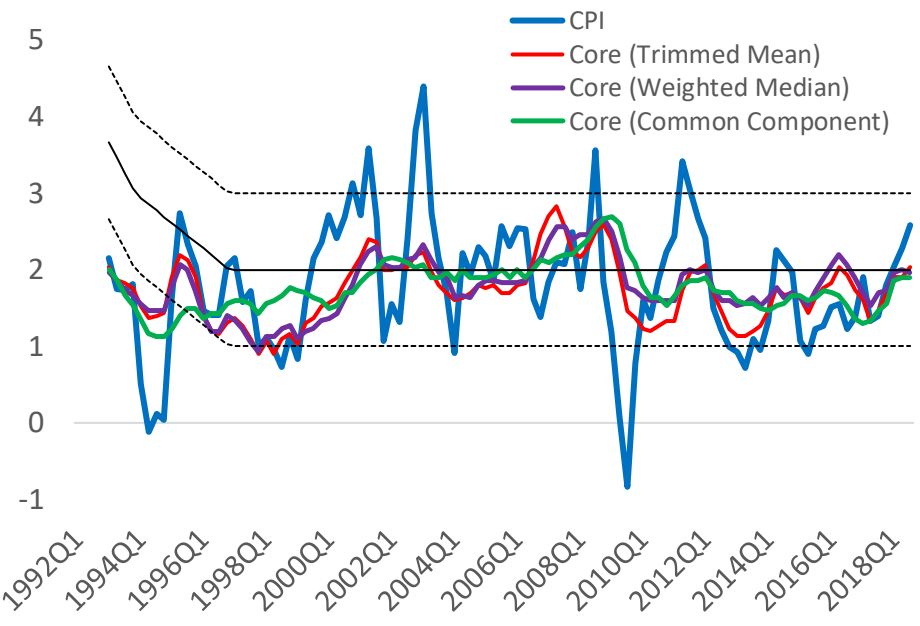
HOW TO IMPROVE INFLATION FORECASTING IN CANADA[1]

Against the backdrop of an ongoing review of the inflation-targeting framework, this chapter examines the real-time inflation forecasts of the Bank of Canada with the aim of identifying potential areas for improvement. Not surprisingly, the results show that errors in forecasting non-core inflation (commodity prices etc.) are found to be the largest contributors to overall inflation forecast errors. Perhaps more importantly, relatively small core inflation forecast errors appear to mask large and offsetting errors related to the output gap and the policy interest rate, partly reflecting a tendency to overestimate the neutral nominal policy rate in real time. Faced with these uncertainties, the Governing Council's gradual approach to changing its policy settings appears to have served it well.

A. Introduction

1. The Bank of Canada has an outstanding record in achieving its inflation objectives. Since it began targeting inflation in 1992, the Bank of Canada has achieved great success in stabilizing inflation. Headline inflation has averaged close to the target of 2 percent, and inflation expectations have been firmly anchored through the ups and downs of the business cycle and bouts of external price shocks.

Figure 1. Canada: Inflation
(percent, year-over year)



Source: Statistics Canada and Bank of Canada

[1] Prepared by Troy Matheson (WHD).

2. The Bank of Canada also has a strong track record at forecasting inflation. Quarterly economic projections made by Bank of Canada staff over a period spanning from 1982 to 2013 have recently been made publicly available, allowing researchers to assess the forecast accuracy of Bank of Canada staff in real time.[2] Champagne and others (2018a) found that staff's short-term forecasts for CPI inflation are significantly more accurate than forecasts produced by several commonly-used econometric models. At longer horizons, staff forecasts were found to compare favorably to forecasts made by Consensus Economics and have similar accuracy to the Governing Council's forecasts published in Monetary Policy Reports.[3]

3. How can inflation forecasts be improved? Given the importance of inflation forecasts in formulating monetary policy decisions in real time, the Bank of Canada is undoubtedly always looking for ways to improve its forecast accuracy. This paper assesses the time-series properties of inflation in Canada against other advanced economies. It then evaluates Bank of Canada staff's inflation forecast errors, with the view to highlight potential areas in which accuracy could be improved going forward.

4. The chapter proceeds as follows. Section B outlines the data used in the analyses. Section C compares the time series properties of inflation in Canada against other OECD countries, and assesses the stability of inflation expectations in Canada. Section D analyzes the forecasting performance of Bank of Canada staff over the inflation targeting period (1992-2013) and section E uses historical decompositions to identify the proximate sources of forecast error experienced over the sample. Section F highlights the importance of estimates of the output gap and the neutral nominal policy rate when forecasting inflation. Section G concludes with a summary of the key findings and policy conclusions.

B. Data

5. The data used come from several sources. The time-series properties of inflation are examined using quarterly OECD data ranging from 2000 to 2018. Core inflation, in this context, is headline CPI inflation excluding Food and Energy. For the Canada-specific analysis, multiple data sources are examined, including data from Statistics Canada, the Bank of Canada, and Consensus Economics. Here, the definition of core inflation is determined by data availability in the Bank of Canada's real time database. Specifically, core inflation is defined as the CPI excluding Food and Energy from 1980Q1 to 2001Q1, and as the CPI excluding the 8 most volatile components from 2001Q2 to 2013Q4.[4]

[2] See https://www.bankofcanada.ca/rates/staff-economic-projections/.

[3] Staff forecasts are a very important part of the analysis presented to the Governing Council every quarter in the weeks leading up to the publication of each Monetary Policy Report.

[4] Both measures exclude the effects of changes in indirect taxes.

C. Time Series Properties of Inflation

6. Since 2000, inflation in Canada has averaged close to the rates seen in other advanced economies, while Canadian inflation outcomes have tended to be less volatile. Table 1 displays means and standard deviation of headline CPI inflation, core inflation, and non-core inflation for Canada and similar statistics for other OECD countries. While there is clearly a diversity of outcomes across the OECD, the results generally show that:

- Canadian inflation (headline, core, and non-core) has averaged very close to the OECD median countries (around 2 percent).
- Headline and core inflation have been less volatile than the median OECD country, while non-core inflation has been slightly more volatile than the median OECD country. Lower volatility could reflect a few factors, including more stable inflation expectations and less inflation persistence and more stable inflation expectations in Canada.

Table 1. Canada: Inflation Statistics Since 2000

(percent, year-over year)

	Canada	OECD *(median)*	OECD *(range)*
CPI Inflation			
Mean	1.9	2.0	[0.1, 4.6]
Std. Dev	0.8	1.2	[0.7, 3.2]
Core Inflation			
Mean	1.7	1.7	[-0.2, 4.7]
Std. Dev	0.6	0.8	[0.3, 2.8]
Non-Core Inflation			
Mean	2.8	2.7	[0.7, 5.9]
Std. Dev	4.4	3.5	[2.1, 6.7]

Source: OECD and staff estimates

Inflation Persistence

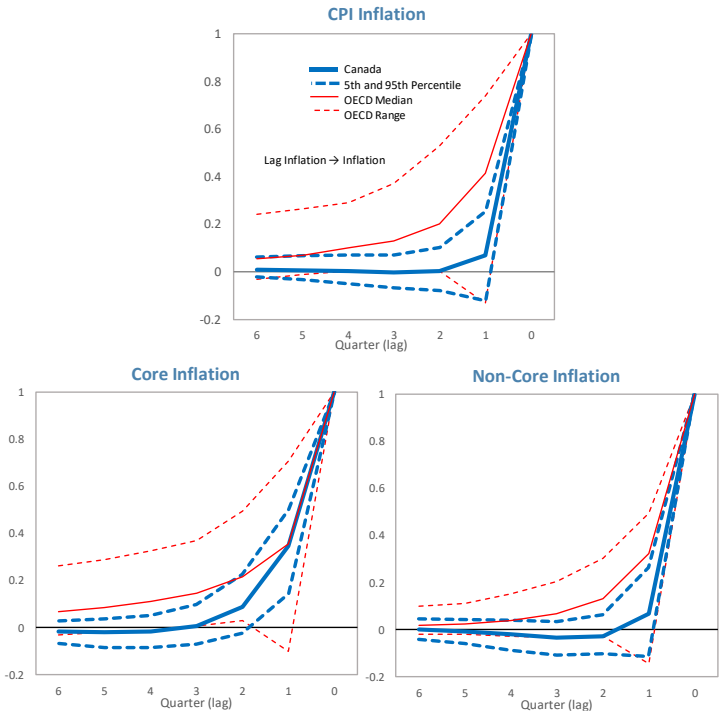
7. Inflation in Canada has been far less persistent than inflation in other advanced economies. Figure 2 displays the persistence of quarterly inflation rates in Canada and other OECD countries, as measured by autocorrelation functions.[5] The results show that inflation is less persistent in Canada than in other countries. For headline inflation and non-core inflation, past inflation rates have no significant predictive power for inflation outcomes. There is slightly more persistence in Canada's core inflation, but it has also tended to be less persistent than core inflation in other countries. Over this sample, the evidence suggests that core inflation has statistically significant predictive power (albeit limited) for core inflation one quarter into the future and not beyond.

8. Core inflation has limited predictive power to forecast headline inflation in Canada. Figure 3 displays cross-correlations between the different inflation rates. Unlike in other OECD countries, past core inflation rates in Canada have no statistical power in predicting headline inflation at any horizon. Indeed, the results suggest that headline inflation is a better predictor of core inflation than the other way around, albeit with less predictive power than seen in the typical OECD country.

[5] The statistics are derived from a vector-autoregressive model (VAR) containing quarterly inflation rates for headline CPI, core CPI, non-core CPI, the output gap (HP-filtered), and the short-term policy rate. The VAR includes 2 lags and is simulated 1000 times using bootstrapping methods.

Figure 2. Canada: Inflation Persistence

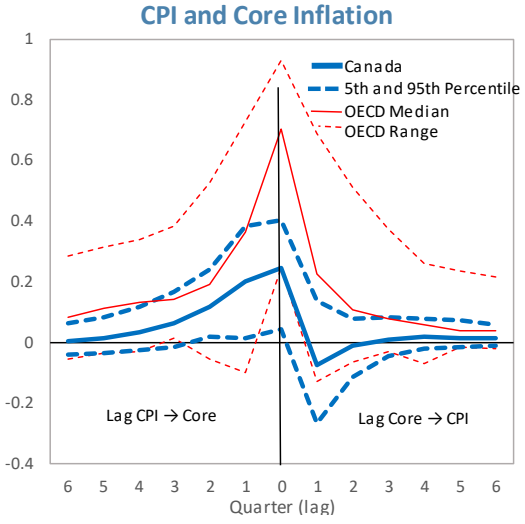
(autocorrelations, quarter-on-quarter)



Source: Staff estimates

Figure 3. Inflation Cross-Correlations

(cross correlations, quarter-on-quarter)

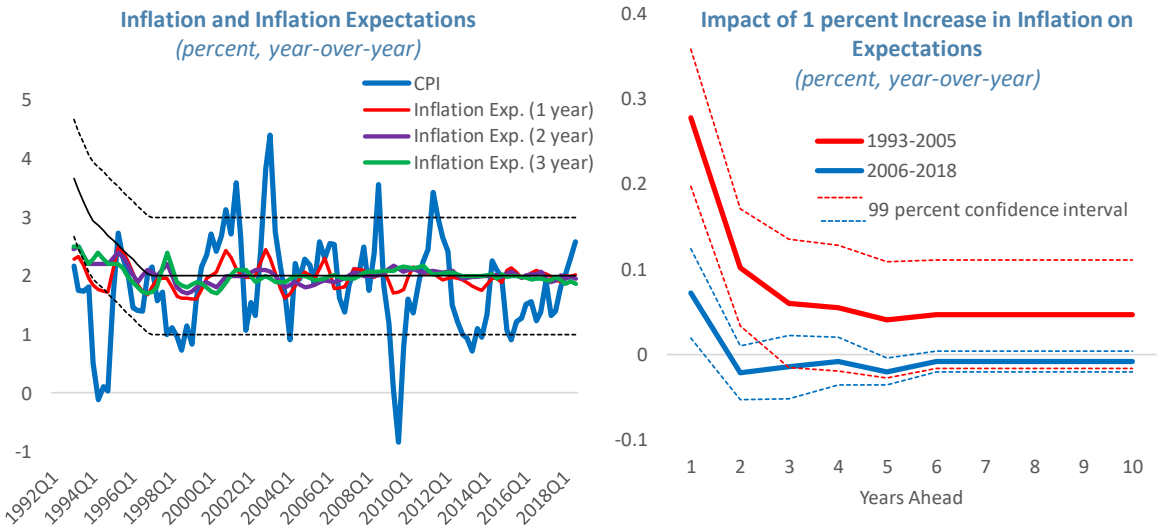


Source: Staff estimates

Inflation Expectations

9. Inflation expectations are remarkably stable, and they have become more anchored over time. The Bank of Canada's proven track record in keeping inflation close to target over time has made monetary policy highly credible. Private sector forecasters generally expect inflation to converge rapidly to the inflation target (figure 4, left-hand side). The credibility of the Bank of Canada in achieving its inflation objective has also improved since the early days of inflation targeting. Figure 4 (right-hand side) shows that the current level of inflation has a very limited impact on the way forecasters see inflation evolving in the future, and that this impact has declined over time. Essentially, because the Bank of Canada is viewed as highly credible in returning inflation back to target, forecasters effectively disregard the current level of inflation when forming their views about future inflation.

Figure 4. Canada: Inflation and Expectations [1/]



[1/]The chart on the right displays the estimated coefficients from regressions of annual inflation expectations from Consensus Economics on current levels of annual inflation. Both variables are expressed as deviations from the inflation target.

Source: Consensus Economics, Bank of Canada Staff estimates

D. Bank of Canada Staff's Inflation Forecast Errors

Inflation Forecast Errors

10. Inflation forecast errors are errors made when predicting annual inflation at various horizons. The annual inflation forecast error at horizon h is defined to be the difference between observed annual inflation in period $t+h$ and the inflation forecast for period $t+h$ made in period t. Specifically, the inflation forecast error is:

$$e_{t+h} = \pi^4_{t+h} - E_t\pi^4_{t+h} \quad (1)$$

where e_{t+h} is the inflation forecast error, for year-over year inflation, π^4_{t+h}, based on the expectation (forecast) of inflation (year-over year) formed in period t, $E_t\pi^4_{t+h}$. The inflation forecast errors described below related to a sample period beginning in 1992Q1 and ending in 2013Q4. The mean forecast error (or 'bias') and mean-squared forecast error (MSE) are then, respectively: $E_t e_{t+h}$, and $E_t e^2_{t+h}$.[6]

11. Three different models are used to examine the forecasting performance of Bank of Canada staff for both headline and core inflation. All forecasts are produced using the same data that were available to the Bank of Canada in real time. The models are:

- ***Simple Model:*** This is a very simple model of Canadian economy that includes a Phillips curve, an IS curve, and a Taylor-type policy rule. The model also allows for the endogenous estimation of the key trends in the economy; potential output, the trend real interest rate, and the neutral nominal policy rate. The model is estimated using Bayesian methods over a sample ranging from 1992 to 2018.[7]

- ***Consensus Economics:*** This model simply takes the average forecast from Consensus Economics for horizon h as the forecast for annual headline inflation and core inflation.

- ***Inflation Target.*** This model simply takes the inflation target as the forecast for both annual headline inflation and core inflation at all horizons.

12. The overall accuracy of staff forecasts is good compared to the other forecasting methods examined, although there appears to be some room for improvement along several dimensions. Forecast error statistics are displayed in table 2. Overall, the forecast comparisons show:

- ***Bias.*** Staff forecasts are less biased than forecasts from the other models, both for headline inflation and core inflation. All other models tend to over predict inflation, particularly for core inflation.

- ***MSE.*** For headline inflation, staff forecasts tend to be more accurate than the other methods up to two years ahead. However, at a horizon of three years, the simple model and the inflation target produce more accurate results. For core inflation, the results are less positive. While the improvements tend not to be statistically significant, the simple model and the inflation target yield more accurate forecasts than Bank of Canada staff at most horizons.

[6] In the terminology of Champagne and others (2018a), all forecasts have the same 'jump-off' point, period *t*.

[7] See the appendix for more details on the model and An and Schofheide (2007) for more details on Bayesian estimation.

Table 2. Canada: Inflation Forecast Errors

	Bias			MSE		
h (quarters ahead)	4	8	12	4	8	12
Headline Inflation						
BoC Staff	0.04	0.02	0.00	0.78	0.82	0.83
	[0.38]	[0.39]	[0.40]			
Simple Model	-0.39	-0.33	-0.18	0.99	0.97	0.69
	[0.01]	[0.06]	[0.16]	[0.17]	[0.33]	[0.09]
Consensus Economics	-0.31	-0.35	-0.29	1.08	1.20	0.86
	[0.08]	[0.09]	[0.11]	[0.13]	[0.26]	[0.39]
Inflation Target	-0.19	-0.28	-0.22	0.93	1.04	0.81
	[0.19]	[0.13]	[0.17]	[0.14]	[0.28]	[0.38]
Core Inflation						
BoC Staff	0.08	0.11	0.05	0.33	0.51	0.33
	[0.29]	[0.31]	[0.37]			
Simple Model	-0.44	-0.35	-0.25	0.40	0.29	0.22
	[0.00]	[0.00]	[0.00]	[0.32]	[0.28]	[0.25]
Consensus Economics	-0.36	-0.36	-0.36	0.34	0.36	0.35
	[0.00]	[0.00]	[0.00]	[0.39]	[0.27]	[0.38]
Inflation Target	-0.24	-0.29	-0.28	0.23	0.28	0.29
	[0.00]	[0.00]	[0.00]	[0.18]	[0.25]	[0.36]

[ ] HAC-adjusted p-value (Newey-West lag length is h - 1). P-values relate to the significance of the constant in Diebold and Mariano (1995) regressions. For MSEs, the test is in relation to the BoC Staff forecast.

Source: Bank of Canada and staff estimates

E. What Went Wrong?

13. Not surprisingly, unforeseen shocks to non-core inflation are by far the largest contributors to Bank of Canada staff's overall inflation forecast errors.[8] Figure 5 displays contributions to staff's headline inflation errors from errors in predicting core and non-core inflation. Non-core inflation forecast errors account for by far the largest share of staff's inflation forecast errors. The largest forecast errors occurred during episodes with particularly large fluctuations (non-core) in commodity and oil prices, particularly around the global downturn in the early 2000s, and around the global financial crisis and the early part of the recovery (2008-2011). While smaller in magnitude, core inflation forecast errors tended to have a negative impact on forecast accuracy in the latter part of the sample (2011 to 2015), reflecting a tendency of staff to overpredict core inflation.

14. Shock decompositions can provide more information on the key contributors to forecast errors. A historical shock decomposition of inflation can be made at any point in time. These decompositions essentially decompose the level of inflation into contributions from idiosyncratic shocks that have hit the economy up to that point, where the idiosyncratic shocks are

[8] This analysis uses $e_{t+h}=\alpha e^{c}_{t+h} + (1-\alpha)e^{x}_{t+h}$ (see equation 1 and the appendix).

determined by the structure and dynamics underpinning the model being used to compute the decomposition. A historical shock decomposition for headline inflation in quarter *t* is:

$$\pi_t^4 - \pi_t^* = \sum_{i=1}^{N} H_t^i \quad (2)$$

where H_t^i is the shock contribution to the deviation of annual headline inflation from the inflation target π_t^* from the *i*th shock, where *N* is the number of shocks contained in the structural model. Using the simple model described in section D, the shock depositions (H_t^i) of inflation from 1992 to 2018 are displayed in figure 6 (top left panel). Since the global financial crisis, this decomposition shows that:

- Negative demand shocks (the output gap) have been a significant drag on inflation and these shocks have been broadly offset by accommodative monetary policy settings (policy rate shocks).
- Non-core inflation is a significant contributor to the volatility of headline inflation. More recently, idiosyncratic shocks to core inflation have also acted to reduce overall inflation.

15. Shock decompositions suggest errors in predicting non-core inflation, the output gap, and the policy rate are key sources of forecast errors. Figure 6 displays historical shock decompositions of staff's inflation forecast errors. Here, the decompositions are the difference in shock contributions to headline inflation from the simple model described above (figure 6, top left panel) and decompositions computed using staff's real-time forecasts.[9] Specifically, forecast errors are decomposed using:

$$e_{t+h} = \sum_{i=1}^{N} (H_{t+h}^i - E_t H_{t+h}^i) \quad (3)$$

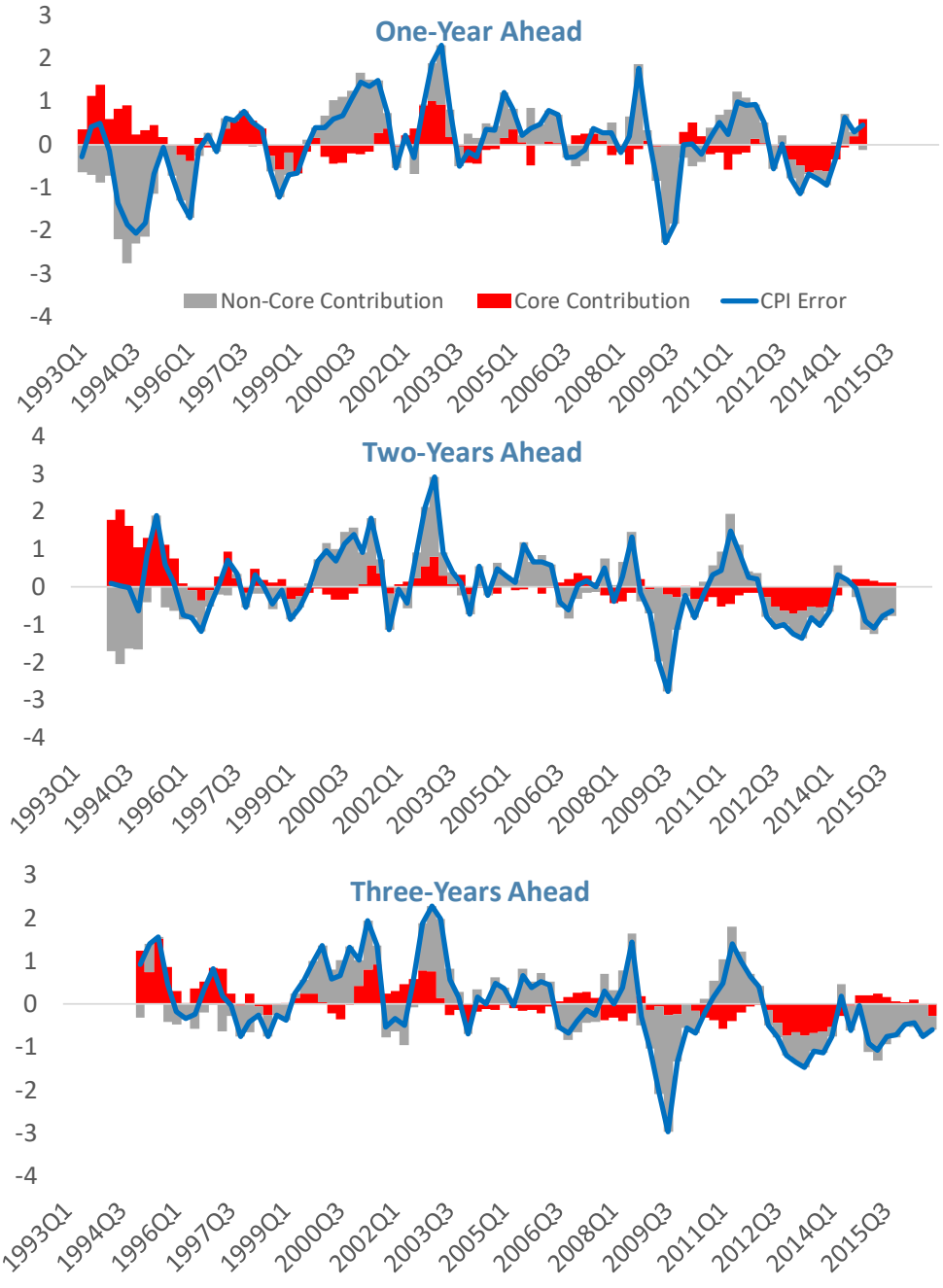
where $E_t H_{t+h}^i$ is the expected contribution to headline inflation (deviation from target) from shock i at horizon *h* formed in period *t*, and $H_{t+h}^i - E_t H_{t+h}^i$ is the contribution to the overall forecast error from the *i*th shock at horizon *h*. The results from the historical shock decompositions of staff's forecast errors over the last 15 years of the sample show that:

- Consistent with the previous results, idiosyncratic shocks to non-core inflation are key contributors to the largest inflation forecast errors.
- At longer forecasting horizons, errors in predicting the output gap and the policy rate play an increasingly important role. In real time, the simple model suggests that staff generally expected the output gap to be stronger and the policy interest rate more contractionary than observed ex-post.

[9] The real-time historical shock decompositions of staff forecasts are computed by running a Kalman filter over the observable data contained in the Bank of Canada's real-time database in each quarter, including the projection period.

Figure 5. Canada: Inflation Forecast Errors and Contributions

(percent, year-over-year)



Source: Bank of Canada and staff estimates.

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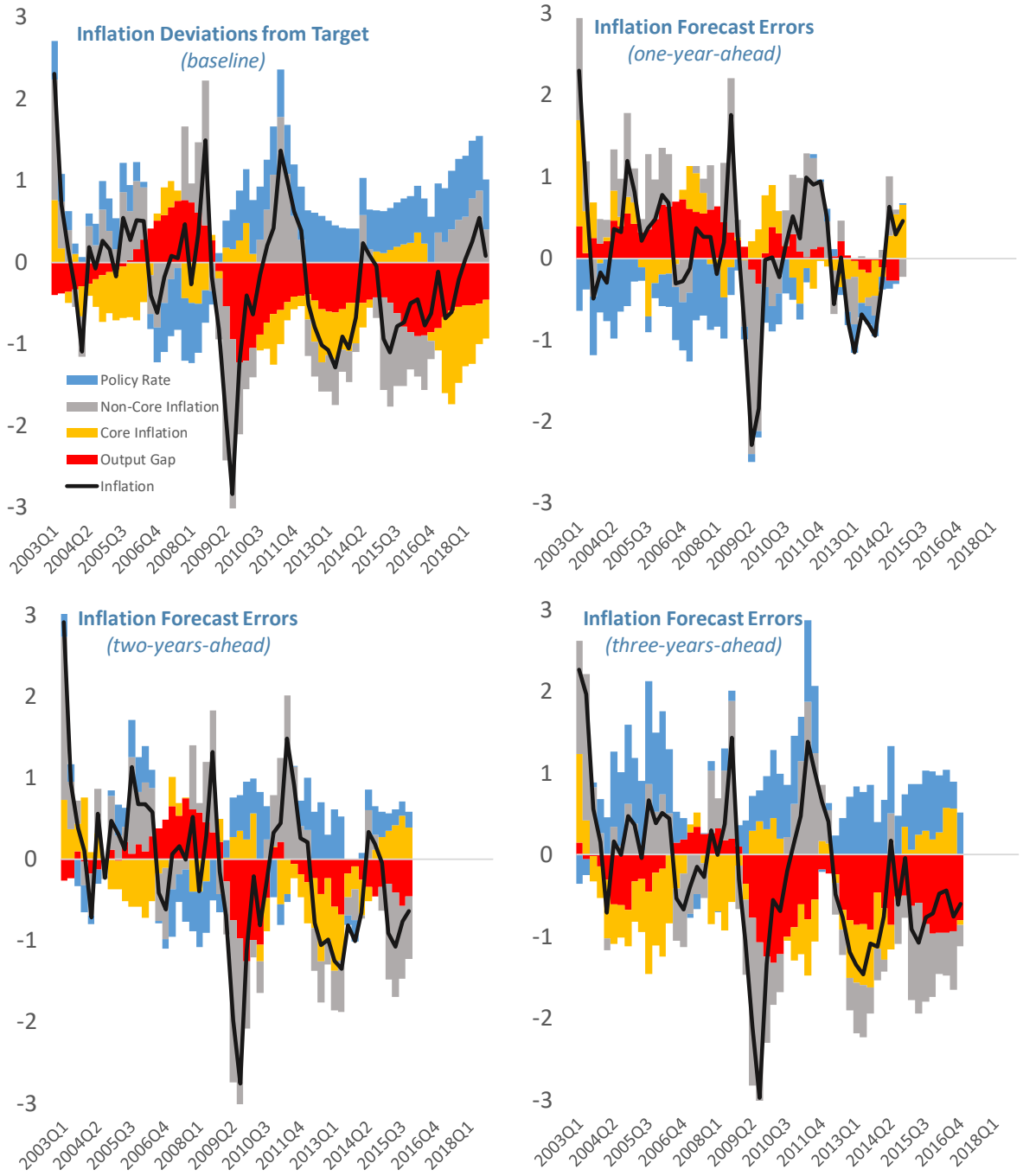
Figure 6. Canada: Historical Shock Dompositions: Inflation and Forecast Errors

(percent, year-over-year; deviations from target; bars are contributions from shocks)



Source: Bank of Canada and staff estimates

F. The Output Gap and the Neutral Nominal Policy Rate in Real Time

16. Estimates of the output gap and the neutral policy interest rate are crucial for making and communicating policy decisions in real time. Figure 7 shows the evolution of the output gap, the policy rate, and the neutral policy rate estimated using data from the whole sample and real-time estimates from Bank of Canada staff. Because the neutral policy rate is not available in the real-time database, the estimates of the neutral policy rate and the policy gap are made using the simple model described in section D.[10]

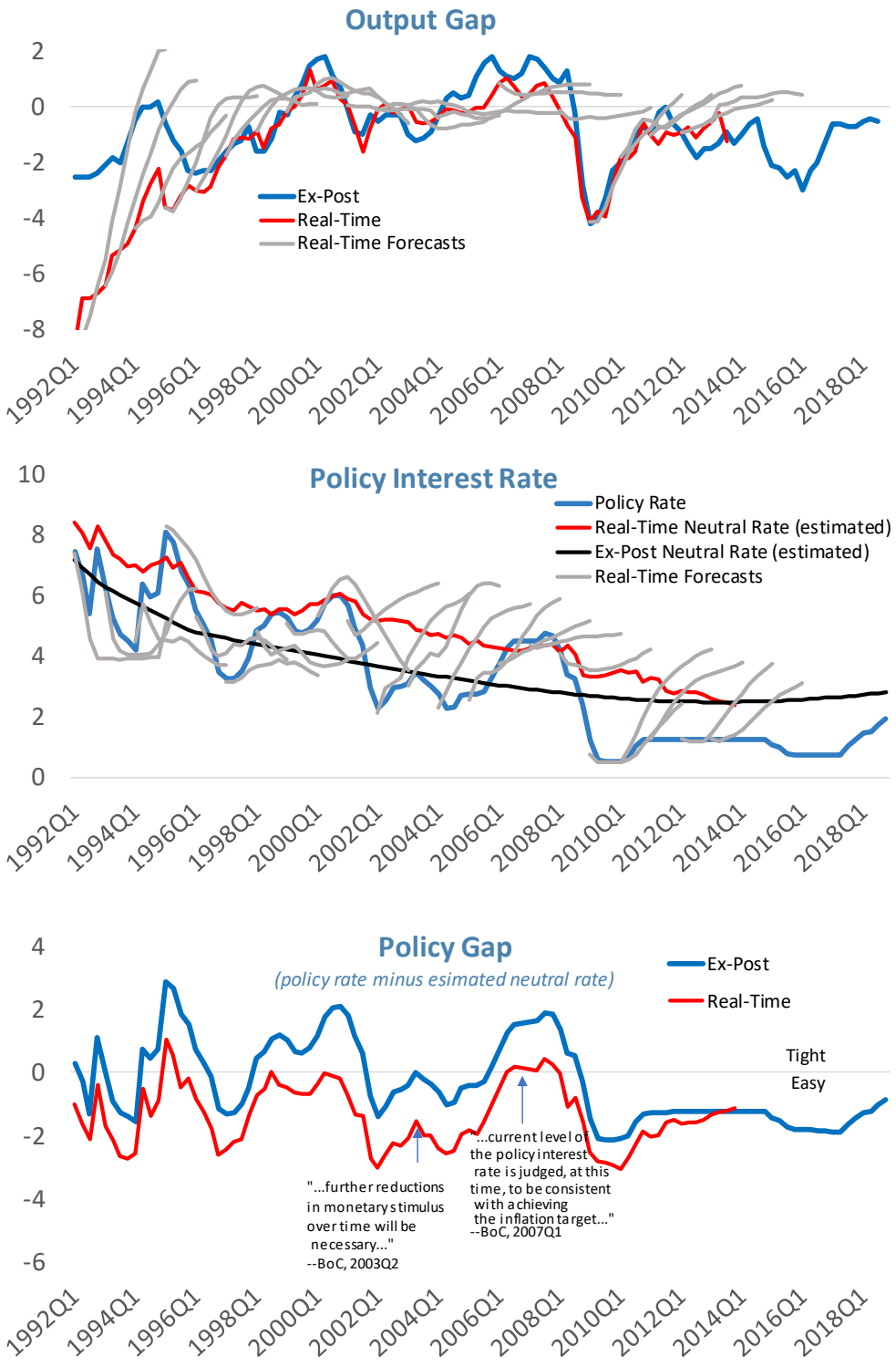
17. Bank of Canada staff have tended to overpredict the output gap and the policy interest rate. As discussed in Champagne (2018b), the magnitude of revisions to real-time estimates of the output gap have generally fallen over time. Consistent with the results from the forecast error decompositions displayed in figure 6, Bank of Canada staff appear to have tendency to overpredict the output gap when making their forecasts, particularly over 1993-1998 and 2011-2014. Staff have also had the tendency overpredict the policy interest rate. Real-time estimates from the simple model suggest that staff might have been systematically overestimating the neutral policy rate over history, and this could have contributed to projections of the policy rate that turned out to be too high ex-post. This is not surprising, given the large and largely unforeseen fall in global interest rates that has occurred over the past 30 years.

18. Overstating the level of the neutral policy rate would lead to very different perceptions of the policy stance (policy gap) in real time. Given real-time estimates of the neutral policy rate, the estimated policy gap is much lower than the gap estimated with all available data. Specifically, estimates from the simple model suggest that the monetary policy was likely perceived to be more accommodative than it was in real time. There also appears to be some support for this view in communications by Bank of Canada that were made in real time.

[10] The real-time estimates of the output gap, neutral policy rate, and policy gap are estimates for the current quarter in each forecast vintage (e.g. the real-time output gap in 2000Q1 is the estimated output gap in 2000Q1 from the 2000Q1 forecast vintage dataset).

Figure 7. Canada: Real-Time Output Gap and Policy Rate

(percent)



Source: Bank of Canada and staff estimates

19. The starting point of a forecast is crucial for determining the policy settings necessary to achieve an inflation objective. Given the lags in the transmission mechanism of monetary policy, central banks focus on inflation forecasts when determining their policy settings. For example, all else equal, estimates of the output gap that are too low will eventually lead a higher-than-expected inflation and may necessitate a higher-than-expected policy rate. Likewise, overestimating the neutral rate of interest in real time would lead to a monetary policy stance that would be perceived to be more accommodative than the actual policy stance in real time, and eventually lead to less monetary tightening than expected. In both these cases, uncertainty about the starting point is crucial in determining the appropriate monetary policy stance in real time, and highlight the risks associated with communication errors, policy reversals, and the potential for an erosion of policy credibility over time.

20. Do starting point errors impact inflation forecast errors in Canada? To answer this question, a simple model is estimated. Staff's core inflation forecast errors $e^{\pi^c}_{t+h}$ are explained by:

$$e^{\pi^c}_{t+h} = a + be^{y}_{t} + ce^{(R-R^*)}_{t} + \varepsilon_{t} \quad (4)$$

where e^{y}_{t} is the starting-point error in estimating the output gap in real time, and $e^{(R-R^*)}_{t}$ is the starting-point error in estimating the nominal policy gap in real time.[11] *a*, *b*, and *c* are constants and ε_t is an idiosyncratic shock. The significance of *b* and *c* indicate whether starting-point errors help to explain core inflation forecast errors. Estimates are made at three different forecast horizons for both the whole sample and the second half of the sample and are displayed in table 3.

Table 3. Canada: Explaining Staff's Core Inflation Forecast Errors

	One-Year-Ahead (h=4)			*Two-Years-Ahead (h=8)*			*Three-Years-Ahead (h=12)*		
Sample: 1992 to 2013	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Output Gap Error	0.17	0.17		0.29	0.30		0.17	0.16	
	[0.00]	[0.00]		[0.01]	[0.00]		[0.00]	[0.01]	
Policy Gap Error	0.16		0.25	0.18		0.34	-0.10		-0.01
	[0.24]		[0.09]	[0.27]		[0.03]	[0.29]		[0.40]
Constant	-0.27	-0.07	-0.24	-0.38	-0.15	-0.33	0.03	-0.09	0.05
Adj. R-Squared	0.22	0.21	0.05	0.44	0.42	0.06	0.17	0.17	-0.01
Sample: 1996 to 2013									
Output Gap Error	0.09	0.09		-0.03	0.03		0.08	0.08	
	[0.38]	[0.17]		[0.34]	[0.34]		[0.17]	[0.17]	
Policy Gap Error	0.26		0.27	0.35		0.33	-0.03		0.02
	[0.09]		[0.07]	[0.04]		[0.07]	[0.39]		[0.39]
Constant	-0.36	-0.05	-0.36	-0.49	-0.08	-0.49	-0.03	-0.07	-0.04
Adj. R-Squared	0.08	0.01	0.09	0.19	-0.01	0.19	0.02	0.03	-0.01

[ ] HAC-adjusted p-value (Newey-West lag length is *h* - 1)
Source: Bank of Canada and staff estimates

21. Errors in estimating the neutral policy rate and the output gap in real time help to explain staff's inflation forecast errors. Over the whole sample, real time errors in estimating the

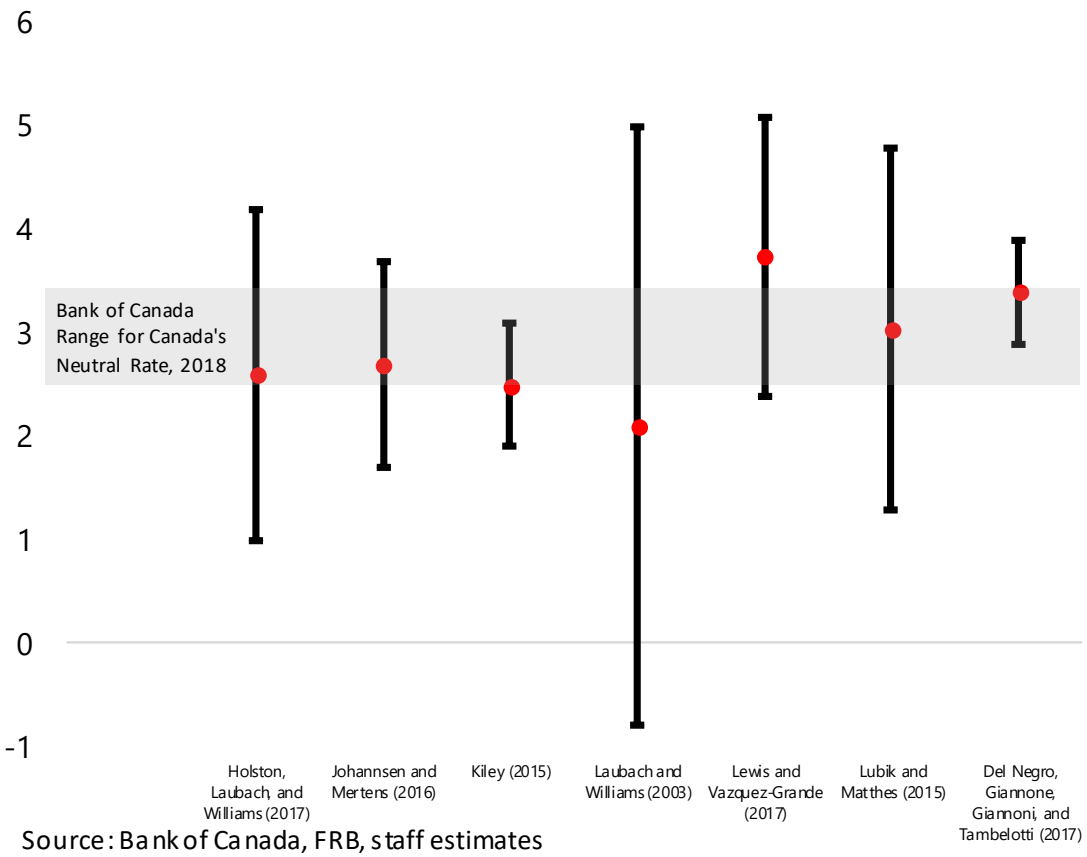
[11] The output gap starting-point error is derived from Bank of Canada staff's real-time database. The nominal policy-gap starting-point error, on the other hand, is estimated using the neutral nominal rate derived from the data available in each real-time database.

output gap contribute to inflation forecast errors at all three forecasting horizons examined. Over the most recent sample, errors in estimating the policy-rate gap appear to be more useful at explaining forecast errors at horizons of one- and two-years ahead. Overall, the results show the importance of starting point estimates of the output gap and the policy rate gap when forecasting inflation and determining the appropriate monetary policy stance in real time.

22. Uncertainty about the neutral nominal policy rate is high, suggesting that a cautious approach to monetary policymaking is warranted. Figure 8 displays estimates of the neutral nominal policy rate in the U.S. and uncertainty around those estimates, and the range of estimates published by the Bank of Canada in 2018. As mentioned above, estimates of global neutral interest rates have been trending down for the past 30 years. Recent estimates for the U.S. and Canada suggest the rate is somewhere around 3 percent in each country, but there is a significant amount of uncertainty around these estimates; the uncertainty bands displayed in figure 8 for the U.S., for example, indicate only a 70 percent level of confidence.

Figure 8. Canada: Recent Estimates of Neutral Policy Rate (U.S.)

(percent, +/- one standard deviation)



Source: Bank of Canada, FRB, staff estimates

G. Summary and Policy Messages

23. The Bank of Canada has an outstanding record in achieving its inflation objective. Since it began targeting inflation in 1993, the Bank of Canada has achieved great success in stabilizing inflation. Headline inflation has averaged close to the target of 2 percent, and inflation expectations have been firmly anchored through the ups and downs of the business cycle and bouts of external price shocks. Since 2000, inflation in Canada has averaged close to the rates seen in other advanced economies, and Canadian inflation outcomes have tended to be less volatile. Inflation is also less persistent than seen in other advanced economies, reflecting very stable inflation expectations and the strong credibility of the Bank of Canada.

24. Bank of Canada staff have a good track record at forecasting inflation, although there appears to be some room for improvement along several dimensions. Staff forecasts are less biased than forecasts from the other models, both for headline inflation and core inflation. On a mean-squared error basis, staff forecasts tend to be more accurate for headline inflation than the other methods examined up to two years ahead. However, at a horizon of three years, more simple forecasting models are at least as accurate (and, depending on the model, sometimes more accurate) than staff forecasts. While the improvements tend not to be statistically significant, the analysis shows that the core inflation forecasts of the Bank of Canada have tended to be less accurate than forecasts produced by both private sector forecasters and more simple forecasting models.

25. Not surprisingly, unforeseen shocks to non-core inflation (commodity prices etc.) are by far the largest contributors to Bank of Canada staff's overall inflation forecast errors. The largest forecast errors have occurred during episodes with particularly large fluctuations in (non-core) commodity and oil prices, particularly around the global downturn in the early 2000s, and around the global financial crisis and the early part of the recovery (2008-2011). While smaller in magnitude, core inflation forecast errors have tended have a negative impact on forecast accuracy in the latter part of the sample (2011 to 2015), reflecting a tendency of staff to overpredict core inflation.

26. Staff's core inflation errors have generally been quite low, but this seems to mask large and offsetting errors in forecasting the output gap and the policy interest rate. At longer forecasting horizons, errors in predicting the output gap and the policy rate play an increasingly important role in explaining inflation forecast errors. A simple model suggests that staff generally expected the output gap to be stronger and the policy interest rate more contractionary than was observed ex-post. The results also show that starting-point errors in estimating the neutral policy rate and the output gap in real time appear to contribute to staff's inflation forecast errors.

27. Uncertainty about the neutral nominal policy rate and the output gap in real time, suggests that the Governing Council's cautious approach to monetary policymaking is warranted. Looking back, the Governing Council has followed a more gradual approach to adjusting its policy settings than suggested by Bank of Canada staff. Given significant uncertainty around real-time estimates of the neutral policy rate and the output gap, this approach seems

appropriate. Staff forecasts—including for the neutral nominal policy rate—serve as key inputs into the policy deliberations of the Governing Council. In this context, the evidence presented here suggests that the Council might also have been systematically overestimating the level of the neutral nominal policy rate over the sample examined and likely tended to misperceive the degree of policy space in real time, which could suggest deficiencies in the communication of the policy stance in real time.

28. The results of this chapter suggest that are several areas in which the Bank of Canada could improve its inflation forecasting performance. Improving real-time estimates of the output gap and neutral nominal policy rate would help to enhance forecast accuracy, and in the communication of the policy stance. Of course, finding ways to further enhance monitoring and forecasting of non-core inflation developments would also help to improve overall inflation forecasting performance. Amid all these uncertainties, the Governing Council's gradual approach to setting monetary policy appears to have served it well.

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Appendix I. Definitions and Model

A. Definitions

(log) Real GDP	Y_t
(log) Potential real GDP	Y_t^*
Output Gap (%)	$y_t = 100 * (Y_t - Y_t^*)$
(log) CPI (same for core and non-core)	P_t
Inflation (quarterly, annualized, %)	$\pi_t = 400 * (P_t - P_{t-1})$
Inflation (year-on-year, %)	$\pi_t^4 = 1/4(\pi_t + \pi_{t-1} + \pi_{t-2} + \pi_{t-3})$
Inflation Target (year-on-year, %)	π_t^*
Neutral Real Interest Rate (annual, %)	r_t^*
Policy Interest Rate (annual, %)	R_t
Neutral Policy Interest Rate (annual, %)	$R_t^* = r_t^* + \pi_t^*$
Real Interest Rate (annual, %)	$r_t = R_t - E_t\pi_{t+1}$
Idiosyncratic Shock to x	ε_t^x

B. Model

IS Curve

$$y_t = \rho_1 E_t y_{t+1} + \rho_2 y_t + \rho_3(r_t - r_t^*) + \varepsilon_t^y$$

Phillips Curve (core inflation)

$$\pi_t^c = E_t\pi_{t+1}^c + \gamma y_t + \varepsilon_t^{\pi^c}$$

Non-Core Inflation

$$\pi_t^x = \omega\pi_{t-1}^x + (1-\omega)\pi_t^* + \varepsilon_t^{\pi^x}$$

Overall Inflation

$$\pi_t = \alpha\pi_t^c + (1-\alpha)\pi_t^x$$

Monetary Policy

$$R_t = \xi_1 R_{t-1} - (1-\xi_1)(R_t^* + \xi_2(\pi_{t+4}^4 - \pi_{t+4}^*) + \xi_3 y_t) + \varepsilon_t^R$$

C. Trends

Potential Output

$$Y_t^* - Y_{t-1}^* = Y_{t-1}^* - Y_{t-2}^* + \varepsilon_t^{Y^*}$$

Real Interest Rate

$$r_t^* = r_{t-1}^* + \varepsilon_t^{r^*}$$

Inflation Target

$$\pi_t^* = \pi_{t-1}^* + \varepsilon_t^{\pi^*}$$

D. Parameters[1]

	Prior Distribution (mean, std.)	*Posterior Mean*	*90 Percent Confidence*
ρ_1	$\Gamma(0.1,0.05)$	0.04	[0.01 ,0.06]
ρ_2	$\Gamma(0.5,0.05)$	0.71	[0.66 ,0.77]
ρ_3	$\Gamma(0.5,0.025)$	0.39	[0.36 ,0.42]
γ	$\Gamma(0.2,0.025)$	0.13	[0.10 ,0.15]
ω	$\beta(0.5,0.1)$	0.69	[0.61, 0.75]
α	Calibrated	0.85	
ξ_1	$\beta(0.9,0.025)$	0.74	[0.71 ,0.79]
ξ_2	$\Gamma(3,0.1)$	3.05	[2.88 ,3.22]
ξ_3	$\Gamma(0.2,0.025)$	0.23	[0.18 ,0.27]
Standard Deviations			
ε^y	$\Gamma^{-1}(1,\infty)$	0.59	[0.44 ,0.71]
ε^{π^c}	$\Gamma^{-1}(1,\infty)$	0.55	[0.44 ,0.66]
ε^{π^x}	$\Gamma^{-1}(1,\infty)$	6.18	[5.22 ,7.56]
ε^R	$\Gamma^{-1}(1,\infty)$	0.42	[0.34 ,0.48]
ε^{Y^*}	$\Gamma^{-1}(1,\infty)$	0.15	[0.13 ,0.19]
ε^{r^*}	$\Gamma^{-1}(1,\infty)$	0.02	[0.02 ,0.03]
ε^{π^*}	$\Gamma^{-1}(1,\infty)$	0.03	[0.02 ,0.04]

[1] Parameters estimated using Metropolis-Hastings, 1,000,000 draws, with a 50 percent burn.

INTERNAL TRADE: CASE FOR LIBERALIZATION[1]

This chapter assesses the costs of internal trade barriers and proposes policies to improve internal trade. Estimates suggest that complete liberalization of internal trade in goods can increase GDP per capita by about 4 percent and reallocate employment towards provinces that experience large productivity gains from trade. The positive impact highlights the need for federal, provincial and territorial governments to work together to reduce internal trade barriers. There is significant scope to build on the new Canadian Free Trade Agreement to more explicitly identify key trade restrictions, resolve differences, and agree on cooperative solutions.

A. Introduction

1. Non-tariff internal trade barriers are often cited as an important factor behind Canada's lagging productivity growth. Non-tariff trade barriers (NTBs) exist due to different regulations across provinces, a consequence of the division of powers and responsibilities between federal and provincial authorities. NTBs hinder labor mobility, limit choice for consumers, fragment markets, stifle competition, and limit the effective scale of production thereby lowering productivity growth[2]. The Canadian Chamber of Commerce (2013) labeled NTBs as one of the top ten obstacles to improving competitiveness in Canada.

2. There are four categories of internal trade barriers in Canada. They include natural barriers, "prohibitive" barriers, technical barriers, and regulatory and administrative barriers (Canadian Federation of Independent Business, 2014). Geographical characteristics, such as distance, are important natural barriers to trade. Prohibitive barriers arise from provincial and territorial laws that unintentionally prohibit internal trade, such as restrictions on the sale of alcoholic beverages to customers in other provinces[3]. Technical barriers stem from sector specific regulations that differ across provinces and territories, such as vehicle weight and dimension standards. Regulatory and administrative barriers stem from provincial and territorial permits, licensing, and other paperwork requirements imposed on businesses that operate in multiple provinces/territories, such as business registry regulation and technical standards and safety certification. Labor mobility, business regulation, transportation, markets for drugs, agricultural products, food and alcohol products, and

[1] Prepared by Jorge Alvarez, Ivo Krznar (both WHD) and Trevor Tombe (University of Calgary) with excellent research assistance provided by Dan Pan. We would like to express a deep gratitude to Denis Caron (Statistics Canada) for his help on the data.

[2] For example, the 2011 Survey on Financing and Growth of Small and Medium Enterprises suggests that SME firms that trade across provincial borders are also more export oriented, more growth oriented, better educated and innovative. On the other hand, only 3.5 percent of firms that do not trade across provincial borders are exporters.

[3] For example, the control and sale of alcoholic beverages in Canada are controlled by provincial governments, where each province has a monopoly system to legislate all aspects of its sale and/or distribution.

until recently, government procurement, have been cited as areas mostly affected by trade barriers (Beckman and others, 2006).

3. This chapter assesses the cost of internal trade barriers and proposes policies to enhance internal trade[4]. We follow the approach by Albrecht and Tombe (2016) to estimate an ad valorem tariff equivalent of NTBs based on the gravity model of trade, taking into account distance and interprovincial border effects. The effects of international and domestic free trade agreements on trade costs are also explored. Counterfactual experiments are performed to assess the effects of lower NTBs on regional and aggregate GDP and employment using a multi-sector, multi-province model of internal trade as in Albrecht and Tombe (2016). The Canadian Free Trade Agreement (CFTA) is assessed and policies are recommended to further improve the internal trade market.

B. Interprovincial Versus International Trade

4. Compared to an ambitious and successful international trade strategy, progress in reducing internal trade barriers across Canada has not kept pace. Since the first free trade agreement with the United States (U.S.) in 1989, Canadian authorities have implemented free trade agreements with 44 countries. Meanwhile, progress in liberalizing internal trade has been slow and, in many cases, international free trade agreements allowed foreign companies better access to Canada than Canadian companies. The Agreement on Internal Trade (AIT) in 1995 did not yield the expected results[5] despite making some progress in areas such as labor mobility, regulation on agricultural products and transparency in government procurement (Industry Canada, 2013). This was mainly due to the AIT's narrow coverage (via a positive list approach)[6], weaknesses in dispute resolution mechanisms, and the absence of agreements in important sectors (OECD, 2016). To address the AIT issues, several provinces entered into regional trade agreements to facilitate trade between the provinces[7]. In 2014, all provinces, territories, and the federal government agreed to

[4] The recent literature shows that the costs of internal trade barriers are sizeable. Agnosteva, Andreson and Yotov (2014) estimate the bilateral trade costs using a panel regression model and find that distance is a significant interprovincial barrier—the average interprovincial tariff equivalent is higher than 100 percent but 5.6 percent after controlling for distance and contiguity. Bemrose, Brown and Tweedle (2017) estimate a 6.9 percent tariff equivalent in goods sectors based on a more granular measure of intraprovincial trade accounting for short-distance intraprovincial flows, and allowing for the presence of zero flows while also mitigating the geographic aggregation bias that plagues other papers. Albrecht and Tombe (2016) find that eliminating their preferred estimate of internal trade costs, would increase GDP between 3-7 percent with largest gains in highly interconnected industries. Bank of Canada (2016) find that a 10 percent reduction in interprovincial trade barriers would raise the potential GDP growth rate by 0.2 percentage points annually. See APEC (2016) and Macmillan and Grady (2007), Palda (1994), Grady and Macmillan (2007), for extensive empirical evidence on the effects of the costs of internal trade barriers.

[5] The Canadian Federation of Independent Business (2014) indicated that only one in ten firms saw benefits from the AIT.

[6] In a positive list approach, only the sectors listed are covered by the trade agreement's rules. In a negative list approach all sectors are covered except specific exceptions.

[7] In 2008, New Brunswick and Quebec signed an agreement to improve labor mobility and skills recognition. In 2009, the Partnership Agreement on Regulation and the Economy (PARE) was signed between New Brunswick

(continued)

update the AIT. In 2017, they signed a new CFTA that adopted a negative list approach, improve procurement coverage and the dispute resolution mechanism, and promote regulatory cooperation.

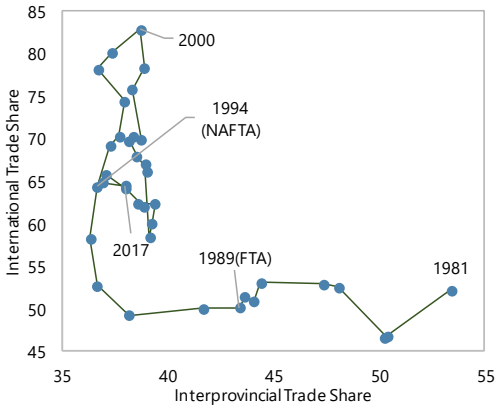
5. Interprovincial trade has lost ground to international trade (Figure 1). The evolution of internal and international trade illustrates three distinct periods. In the early 1980s, the volume of interprovincial and international trade (exports plus imports as a share of GDP) was about the same—55 percent of GDP. For the next 10 years, interprovincial trade steadily shrank to less than 40 percent and stayed constant at that level until 2017. Over the same period international trade expanded to more than 80 percent following the signing of the Canada-U.S. Free Trade Agreement (in 1989) and the North American Free Trade Agreement (NAFTA) (in 1994)[8]. The boom in international trade came to a halt with the dot-com bust in the early 1990s and the volume of international trade came down to about 65 percent of GDP in 2017. This was still 25 percentage points higher than interprovincial trade. Nevertheless, while international trade in goods is much larger than interprovincial trade, interprovincial trade in services (such as information services, finance, insurance and real estate services, warehousing, wholesale trade and professional services) account for more than a half of total interprovincial trade relative to only 10 percent of international trade in services. Growth of interprovincial trade in the period from 1982 to 2017 has mainly been driven by British Columbia, Saskatchewan, Manitoba, and Alberta, the provinces most open to internal trade (based on the share of internal trade in GDP). This likely reflects an increase in the value of internal trade in natural resources (crude petroleum, potash and other minerals).

and Nova Scotia to streamline practices, remove duplication, and harmonize regulations. In 2009, the Ontario-Quebec Trade and Cooperation Agreement (TCA) was signed to increase harmonization and labor mobility and improve dispute resolution. New West Partnership Trade Agreement (NWPTA) was signed in 2010 between Alberta, British Columbia and Saskatchewan, building on the 2006 Trade, Investment and Labor Mobility Agreement (TILMA) between Alberta and British Columbia. Manitoba joined the partnership in 2017. Compared to the AIT, the agreement improved on sector coverage (via a negative list approach), mutual recognition of provinces' regulations related to trade, investment and labor, government procurement and corporate registration and reporting system. Joint Regulatory and Service Effectiveness Office was created by a memorandum of understanding, which was signed between Nova Scotia and New Brunswick in 2015 to improve the regulatory environment between the two provinces.

[8] There is some evidence that the decrease in the interprovincial trade share might be attributed to trade diversion of the 1989 Free Trade Agreement (Helliwell, Lee and Messinger, 1999).

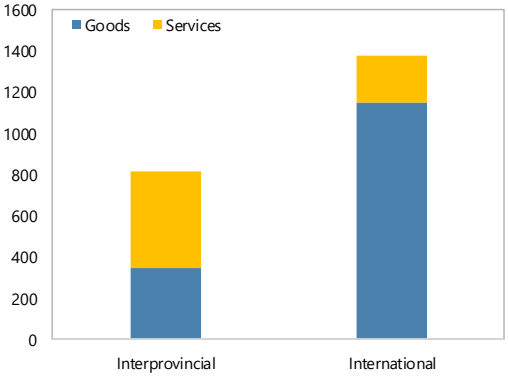
Figure 1. Canada: Interprovincial and International Trade

Interprovincial and International Trade, 1981-2017
(Percent of GDP)

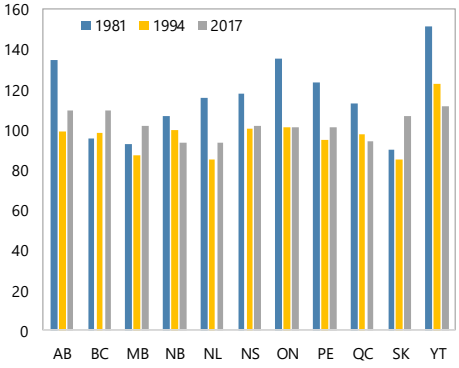


Average Growth of Nominal Exports
(Y/Y percent change)

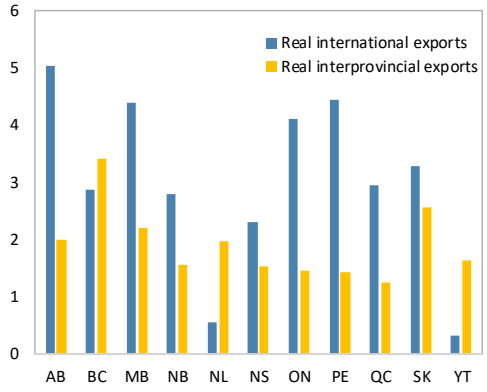
Trade Flows
(2017, billion Can$)



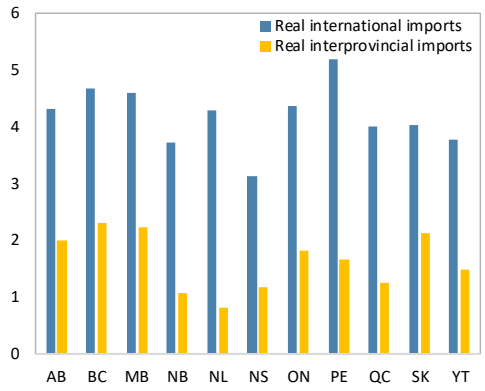
Real Interprovincial Trade Relative to Size of Economy
(Index, 2002=100)



Real Exports by Province
(Y/Y percent change, avg. 1982-2017)



Real Imports by Province
(Y/Y percent change, avg. 1982-2017)



Source: Statistics Canada.

C. Estimating the Costs of Internal Trade Barriers: Methodology

6. Measuring internal trade costs directly is not feasible. The list of NTBs is daunting (see Beaulieu and others (2003) and APEC (2016) for a comprehensive overview of NTBs in Canada). Constructing indices that reflect the restrictiveness on NTBs across provinces and different sectors was beyond the scope of this chapter. While the federal government commissioned Ernst & Young (EY) to create an index of Canadian internal trade barriers (APEC, 2016), the data were not publicly available. The findings of the EY report are being used by federal, provincial and territorial governments to inform the CFTA's Regulatory Reconciliation and Cooperation Table's (RCT) work plan, which identifies barriers to trade, investment and labor mobility within Canada and establishes working groups to undertake the work to reconcile trade barriers[9].

7. An indirect method is used to estimate the costs of internal trade barriers. Interprovincial bilateral trade flows are used to infer the cost of NTBs between provinces, the U.S. and the Rest of the World (ROW) in different sectors[10]. As in Albrecht and Tombe (2016), data on trade flows are used to infer unobservable total trade costs between provinces (relative to the cost of trading within provinces) from bilateral import shares[11]. A measure of aggregate trade costs is computed for every year, sector and trading pair. The intuition behind the measure is simple: if bilateral flows are lower relative to domestic trade flows, that means interprovincial trade barriers make it difficult for the two provinces to trade with each other relative to trading within the province. The objective is to estimate ad valorem equivalents of NTBs to allow for an easy comparison of total trade costs between trading partners and different sectors. Using panel regression analysis,[12] the measures are decomposed into a geographic component—driven by distance[13] and border effects—and a residual non-geographic, policy relevant component (see Appendix I for the details of the methodology). Ad valorem equivalents of the non-geographic NTBs are then used in a multi-sector model to assess the effects of trade barriers on GDP and employment.

[9] The RCT's 2019-2020 work plan can be found on the CFTA's website (https://www.cfta-alec.ca/regulatory-reconciliation-cooperation/).

[10] Another approach would be to study price data on comparable goods in different provinces. This approach was not feasible as the data on comparable prices were not available.

[11] This trade cost measure can be derived from a broader range of micro founded trade (gravity) models such as Anderson and van Wincoop (2003), Eaton and Kortum (2003), Chaney (2008) and Melitz and Ottaviano (2008) - see Novy (2011) for the derivation.

[12] See Appendix II for the detailed methodology.

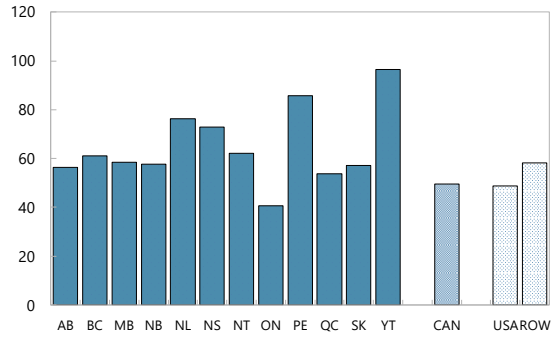
[13] Distance based on population-weighted centroids for each province, the U.S., and ROW is used in the analysis. See Bemrose et al. (2017) for a discussion on how lack of information on intraprovincial trade flow distances introduces upward biases in the measurement of barriers. Point-to-point intraprovincial trade flow data is not publicly available for all years, sectors, territories and trade flows covered by this study.

8. The sample includes 12 Canadian provinces and territories[14], the U.S. and the rest of the world (see Appendix II for a detailed description of the data). The sample spans from 1997 to 2015. To make different data sources consistent, sector classification of output, expenditure and trade data of each trading partner are reclassified to 18 new goods and services[15] sectors.[16] In addition, data on bilateral distances, population, contiguous borders and elasticities of substitution at the sector level are used in the estimation. Dummy variables[17] for regional agreements, including TILMA (2007), the New Brunswick-Quebec agreement (2009), NWPTA (2011[18]), PARE (2010) and the Ontario-Quebec agreement (2010), are constructed to study their effects on trade costs within Canada[19].

D. Estimates of the Costs of Internal Trade Barriers

9. Total costs of NTBs (geographic and non-geographic) differ significantly by province, at times surpassing the costs of international trade barriers. Ontario and Quebec have the lowest trade-weighted average cost of NTBs in the last year of the sample (2015). In contrast, the more isolated provinces of Prince Edward Island, Newfoundland and Labrador, Nova Scotia and Yukon have the highest average cost. Several provinces have higher average NTB costs than those measured for international trade flows, especially those involving the U.S. This pattern reflects the relatively low trade inter-connectivity between some provinces relative to their international linkages. These cost measures, however, include both policy- and geography-driven differences of which distance plays a significant role in the latter.

Total Trade Barriers by Province
(Trade-weighted average, percent)



Sources: STATCAN; and staff calculations.

[14] Data for Northwest Territories and Nunavut were merged to have a consistent dataset before and after 1999 when Northwest Territories were divided into two territories.

[15] We thank Denis Caron at Statistics Canada for providing estimated service trade data with the U.S., by province. Two assumptions were used to estimate the data. First, the concordance between Balance of payments' service categories and Input-Output commodities (IOCC at Detail level) on which this exercise is based might not necessarily reflect final balancing operations to the input-output matrix. Second, for the same IOCC commodity (at Detail level) the proportion of services traded with the U.S. is the same for each province. This is due to the limitation of the data source used.

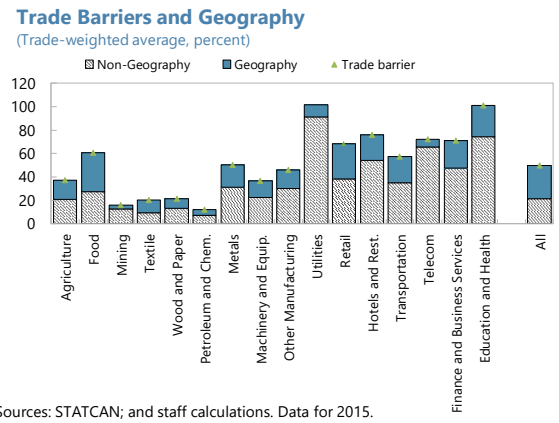
[16] International service flows data are only available from 2010 to 2015.

[17] For simplicity the dummy variables are constructed based on provinces involved and take the same value across all sectors.

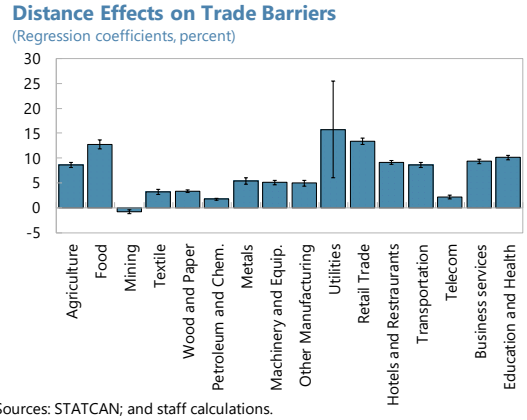
[18] Manitoba joined the agreement in 2017. However, the effects on trading costs in Manitoba were not assessed because the sample ended in 2015.

[19] It is assumed that possible effects of the specific agreement come in the first year after the agreement was signed.

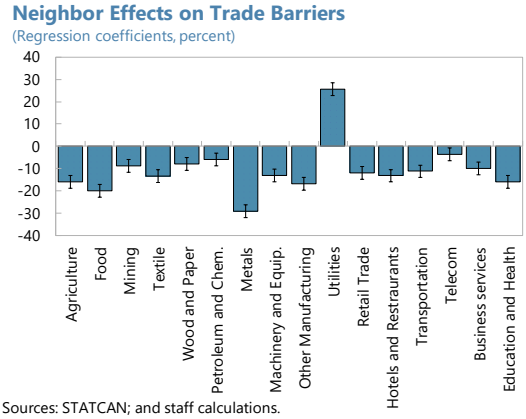
10. Geographic characteristics account for more than half of trade barriers. Geography accounts for 57 percent of total trading barriers across all regions and trading routes.[20] The aggregate effect of geography depends on how distance and border effects interact with established trading routes and the composition of trade. The regression estimates suggest that an extra 1,000 km of distance between trading partners is associated with a trading barrier increase of around 3-13 percent for agricultural and food products and most manufacturing goods. Distance effects are highest for utilities and retail trade services and lowest for petroleum, chemicals and mining. In addition, bordering a trading partner is associated with a barrier reduction of 4-30 percent, with the largest effects being observed in agriculture and food products, metals, electrical machinery, textiles, and other manufacturing.[21]



Sources: STATCAN; and staff calculations. Data for 2015.



Sources: STATCAN; and staff calculations.



Sources: STATCAN; and staff calculations.

11. Non-geographic trade barriers account for 43 percent of total trade barriers. The average[22] tariff-equivalent of non-geographic barriers in 2015 was 21 percent. Across sectors, these range from 7 percent for textiles, petroleum and chemicals to over 27 percent for heavier metals, food products and other manufacturing goods, and significantly higher for services. This cross-sectoral variation reflects both the nature of goods and services traded as well as their interaction with trading patterns and sector-specific regulations in different provinces.

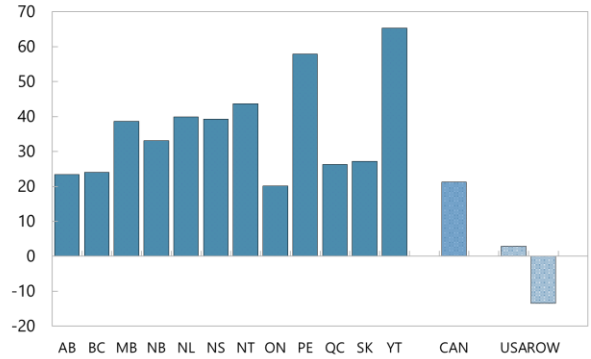
[20] This represents the trade-weighted average contribution of geography variables to total trade barriers.

[21] The border effect is positive for utilities due to the lack of trade data in this sector between bordering regions.

[22] All averages are weighted by total trade flows.

12. Non-geographic trade barriers differ substantially by province. Alberta, British Columbia, and Ontario exhibit the lowest non-geographic barriers. In contrast, the relatively less connected provinces of Manitoba, Prince Edward Island, Nova Scotia, Yukon, and Newfoundland and Labrador exhibit the highest barriers, even when accounting for geographic distance and neighboring effects. The magnitudes of these barriers are larger than those measured for the U.S. and the rest of the world, though it is hard to assess the average effect of geographic variables on international trade flows.[23]

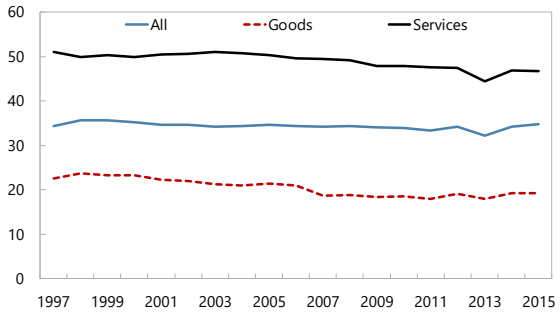
Non-geographic trade barriers by province
(Trade-weighted average, percent)



Sources: Statistics Canada; and staff calculations.

13. Average non-geographic barriers in goods and services have fallen slightly since 1997, with substantial variation across sectors. Domestic trade-weighted averages of non-geographic barriers for all goods declined from 23 percent in 1997 to 19 percent in 2015. For services, there was a similar decline from 51 to 47 percent during the same period[24]. However, there is substantial variation across sectors and provinces when comparing changes between 1997 and 2015 (Table 1). Barriers were reduced mainly in agricultural goods, food, textiles, utilities, transportation and business services, while trade barriers increased in the telecommunications, metals, and machinery and equipment sectors. Across provinces (Table 2), Yukon, Prince Edward Island, and Saskatchewan saw the largest fall in non-geographic trade barriers, potentially reflecting recent efforts to integrate remote provinces.

Non-Geographic Trade Barriers, Domestic Only
(Trade-weighted average, percent)



Sources: STATCAN; and staff calculations
Note: Trade-weighted average of inter-provincial flows. International flows excluded.

[23] The analysis of international trade barriers between provinces and rest of the world (including the U.S. as one trading partner) was distorted by the measure of distance between the provinces and the rest of the world. For example, it is reasonable to assume that some U.S. states would trade easier with neighboring Canadian provinces. Geographic distance between provinces, the U.S., and ROW is measured based on population-weighted centroids and neighbor effects are coded as 0 for ROW. Based on these geographic characteristics, the model predicts lower international flows than observed, and the resulting average non-geographic component is negative. It is likely that the geographic measures for international partners overstate the effect of geography. Ideally, detailed trade data between the provinces and the U.S. states (or other countries) could be used to construct a more relevant measure of distance.

[24] These declines are less pronounced if we include international flows. The overall average cost for goods and services combined remained stable due to the increased importance of service trade over time.

Table 1. Canada: Costs of Trade Barriers by Sector

(percent)

	1997			2015			1997-2015 Change	
Sector	Trade barrier	Geography	Non-Geography	Trade barrier	Geography	Non-Geography	Trade barrier	Non-Geography
Agriculture	43.1	12.7	30.4	37.4	16.6	20.8	-5.7	-9.6
Food	79.1	28.9	50.2	60.5	33.1	27.4	-18.6	-22.8
Mining	14.3	5.4	8.9	15.8	3.2	12.6	1.6	3.8
Textile	29.0	11.2	17.8	20.4	11.1	9.3	-8.5	-8.5
Wood and Paper	20.4	8.0	12.4	21.5	8.3	13.2	1.1	0.8
Petroleum and Chemicals	10.8	4.9	5.9	12.2	4.9	7.3	1.4	1.4
Metals	45.9	18.8	27.1	50.5	19.3	31.2	4.6	4.1
Machinery and Equipment	30.5	15.0	15.5	37.0	14.6	22.4	6.5	6.9
Other Manufacturing	44.1	16.7	27.4	46.1	15.8	30.3	2.1	2.9
Utilities	111.7	12.4	99.4	101.5	10.5	91.0	-10.3	-8.4
Wholesale and retail trade	60.4	24.5	35.9	68.2	29.5	38.7	7.8	2.7
Hotels and Restraurants	73.7	20.0	53.7	76.1	21.8	54.2	2.3	0.5
Transportation and warehousing	63.6	19.9	43.7	57.7	22.5	35.2	-5.9	-8.5
Post and Telecommunications	60.5	6.4	54.2	72.1	6.4	65.7	11.6	11.5
Business services	84.2	22.4	61.8	71.2	23.4	47.8	-13.0	-14.0
Education and Health	96.9	22.5	74.4	100.8	26.7	74.1	3.9	-0.3
All	51.8	17.5	34.4	55.1	20.3	34.8	3.2	0.4

Source: STATCAN; and staff calculations.

Note: Trade-weighted averages excluding international flows. Government services and construction flows between provinces not available.

Table 2. Canada: Costs of Trade Barriers by Provinces

(percent)

	1997			2015			1997-2015 Change	
	Trade barrier	Geography	Non-Geograpy	Trade barrier	Geography	Non-Geograpy	Trade barrier	Non-Geograpy
AB	48.3	20.2	28.2	50.6	22.2	28.3	2.3	0.2
BC	59.6	26.6	33.0	59.2	28.0	31.2	-0.4	-1.7
MB	59.7	17.7	41.9	59.1	17.4	41.7	-0.5	-0.2
NB	57.8	12.9	44.9	61.0	15.2	45.8	3.2	0.9
NL	83.0	23.4	59.6	73.2	23.2	50.0	-9.8	-9.6
NS	62.8	19.5	43.3	66.9	21.5	45.4	4.1	2.1
ON	48.9	17.4	31.5	53.5	21.5	32.0	4.5	0.4
PE	79.7	17.0	62.6	74.0	16.2	57.8	-5.7	-4.9
QC	45.9	11.2	34.8	53.3	13.9	39.4	7.4	4.7
SK	56.1	16.2	40.0	52.7	15.8	36.9	-3.5	-3.0
YT	104.6	28.9	75.7	90.6	24.3	66.2	-14.0	-9.4
Canada	51.8	17.5	34.4	55.1	20.3	34.8	3.2	0.4

Source: STATCAN; and staff calculations.

Note: Trade-weighted averages excluding international flows.

Table 3. Canada: Dynamics of Costs of Non-geographic Trade Barriers

(Goods, percent)

2015

	AL	BC	MB	NB	NL	NS	ON	PE	QC	SK	YT
AL	0	24	21	25	26	26	10	54	17	24	38
BC	24	0	27	29	36	27	10	42	17	28	41
MB	21	27	0	33	62	28	28	60	27	29	46
NB	25	29	33	0	19	29	30	29	35	38	52
NL	26	36	62	19	0	32	30	45	47	58	34
NS	26	27	28	29	32	0	27	36	32	46	50
ON	10	10	28	30	30	27	0	41	26	20	26
PE	54	42	60	29	45	36	41	0	51	80	30
QC	17	17	27	35	47	32	26	51	0	35	45
SK	24	28	29	38	58	46	20	80	35	0	67
YT	38	41	46	52	34	50	26	30	45	67	0

1997

	AL	BC	MB	NB	NL	NS	ON	PE	QC	SK	YT
AL	0	30	23	53	57	40	12	75	22	30	57
BC	30	0	33	39	57	34	16	75	24	36	49
MB	23	33	0	58	69	49	35	87	33	37	86
NB	53	39	58	0	44	33	31	46	41	59	88
NL	57	57	69	44	0	36	40	60	63	60	62
NS	40	34	49	33	36	0	32	49	36	51	75
ON	12	16	35	31	40	32	0	48	26	25	57
PE	75	75	87	46	60	49	48	0	52	76	48
QC	22	24	33	41	63	36	26	52	0	37	58
SK	30	36	37	59	60	51	25	76	37	0	71
YT	57	49	86	88	62	75	57	48	58	71	0

Change 1997-2015

	AL	BC	MB	NB	NL	NS	ON	PE	QC	SK	YT
AL	0	-6	-2	-27	-31	-14	-2	-21	-5	-5	-19
BC	-6	0	-5	-11	-21	-6	-6	-33	-6	-8	-8
MB	-2	-5	0	-24	-7	-21	-7	-27	-6	-9	-40
NB	-27	-11	-24	0	-25	-4	-1	-17	-6	-21	-36
NL	-31	-21	-7	-25	0	-4	-10	-15	-16	-1	-28
NS	-14	-6	-21	-4	-4	0	-5	-13	-4	-5	-25
ON	-2	-6	-7	-1	-10	-5	0	-8	0	-5	-31
PE	-21	-33	-27	-17	-15	-13	-8	0	-1	4	-18
QC	-5	-6	-6	-6	-16	-4	0	-1	0	-2	-13
SK	-5	-8	-9	-21	-1	-5	-5	4	-2	0	-4
YT	-19	-8	-40	-36	-28	-25	-31	-18	-13	-4	0

Source: Staff calculations.

Note: Trade weighted averages excluding international flows.

14. There is some evidence of regional integration in goods trade[25], although there remains significant room for improvement. The heatmap of trade barriers (Table 3) show an increasingly more integrated Canadian economy over the years. Barriers affecting trade routes between major provinces—Alberta, British Columbia, Ontario, and Quebec—have declined, but by less than the changes between other provinces. Regions that were relatively disconnected from non-bordering regions such as Nova Scotia, Prince Edward Island, Yukon, and Newfoundland and Labrador, have significantly reduced barriers with several trading partners, including non-bordering provinces.

15. There is also evidence that inter-provincial trade agreements are associated with lower non-geographic trade barriers. Trade-weighted regressions using trade agreement dummies indicate that provincial routes affected by the free trade agreements saw higher trade flows than other routes (Table 4). This appears to be true for TILMA, the 2009 New Brunswick-Quebec agreement, PARE, and NWPTA. The signing of these trade agreements was associated with an average reduction of trade barriers between 1 and 4 percent based on weighted estimates. These effects were likely driven by regulatory changes in specific sectors, and a re-orientation of trade flows towards sectors and trade routes with lower inter-provincial barriers.

Table 4. Canada: Trade Agreements and Trade Barriers

								Goods only	
Variables	log(t)	log(t)	log(t)	log(t)	log(t)	log(t)	log(t)	log(t)	log(t)
2007 TILMA	-0.0373***					-0.0301***	-0.00719	-0.0403***	-0.0158**
	(0.00366)					(0.00412)	(0.00437)	(0.00669)	(0.00700)
2009 NB-QC agreement		-0.0437***				-0.0446***	-0.0237***	-0.0527***	-0.0284**
		(0.00723)				(0.00722)	(0.00746)	(0.0114)	(0.0117)
2010 PARE			-0.0208*			-0.0218**	0.00228	-0.0399**	-0.0120
			(0.0107)			(0.0106)	(0.0109)	(0.0174)	(0.0178)
2010 TCA				0.00876**		0.00949**	-0.00201	-0.0158***	-0.00754*
				(0.00213)		(0.00213)	(0.00232)	(0.00370)	(0.00386)
2011 NWPTA					-0.0232***	-0.0130***	0.00268	-0.00874*	0.00273
					(0.00285)	(0.00320)	(0.00355)	(0.00513)	(0.00561)
Trading pair fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year * Eporter fixed effec	No	No	No	No	No	No	Yes	No	Yes
Observations	36,060	36,060	36,060	36,060	36,060	36,060	36,060	19,782	19,782
R-squared	0.991	0.991	0.991	0.991	0.991	0.991	0.992	0.988	0.988

Source: STATCAN; and staff calculations.
Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

[25] We show the results with respect to trade in goods only because trade service flows do not exist for all provincial pairs.

Table 5. Canada: Trade Growth Decomposition

Agreement (provinces)	2015 Trade	Change since agreement	Contribution of growth in production	Contribution of trade barrier decline	Contribution of decline in multilateral resistance	Total
NWPTA and TILMA (AL-BC)						
Agriculture	1,250	360	-20%	54%	66%	100%
Food	2,411	448	-37%	115%	22%	100%
Mining	4,183	807	-38%	122%	15%	100%
Textile	23	-341	163%	3%	-66%	100%
Wood and Paper	1,145	-641	201%	13%	-114%	100%
Petroleum and Chemicals	3,845	141	-561%	75%	587%	100%
Metals	921	-142	268%	194%	-362%	100%
Electrical and Machinery, and	1,126	200	-462%	370%	192%	100%
Other Manufacturing	336	72	2%	-247%	345%	100%
NB - QC agreement (NB - QC)						
Agriculture	532	411	16%	90%	-6%	100%
Food	815	385	55%	94%	-49%	100%
Mining	136	88	34%	164%	-98%	100%
Textile	28	-	-	-	-	-
Wood and Paper	333	-159	38%	101%	-40%	100%
Petroleum and Chemicals	1,026	-871	116%	53%	-70%	100%
Metals	782	488	6%	101%	-7%	100%
Electrical and Machinery, and	230	68	40%	34%	26%	100%
Other Manufacturing	107	3	36%	32%	31%	100%
PARE (NB - NS)						
Agriculture	256	-46	-137%	200%	37%	100%
Food	309	86	68%	202%	-170%	100%
Mining	21	-	-	-	-	-
Textile	10	-	-	-	-	-
Wood and Paper	228	29	560%	211%	-671%	100%
Petroleum and Chemicals	588	153	867%	-697%	-69%	100%
Metals	91	36	45%	121%	-66%	100%
Electrical and Machinery, and	50	25	26%	-84%	158%	100%
Other Manufacturing	81	35	6%	75%	20%	100%
TCA (ON - QC)						
Agriculture	1,792	430	30%	43%	27%	100%
Food	10,162	1,083	33%	-29%	96%	100%
Mining	3,628	1,655	55%	66%	-20%	100%
Textile	598	-	-	-	-	-
Wood and Paper	3,178	-334	444%	26%	-370%	100%
Petroleum and Chemicals	6,249	-917	101%	171%	-172%	100%
Metals	5,692	484	266%	-183%	17%	100%
Electrical and Machinery, and	3,865	-1,949	-65%	145%	20%	100%
Other Manufacturing	1,617	197	120%	119%	-139%	100%

Source: STATCAN; and staff calculations.

Notes: Decomposition of change in trade flows since signing of agreement. For NWPTA-TILMA, the signature year of TILMA was used.

16. Growth in trade among provinces that signed internal trade agreements was largely driven by a decline in measured trade barriers (Table 5). The gravity framework is used to examine the driving forces behind the growth of interprovincial trade following the signing of free trade agreements. For every sector, the growth of bilateral trade can be decomposed into contributions from the growth of local production, the change in bilateral trade barriers (for example due to regional free trade agreements) and the change in multilateral barriers due to trade diversion effects (for example due to international free trade agreements).[26] Trade among these provinces grew in most sectors between the year of the agreement's signing and the last year of our sample. For the majority of sectors, the decomposition suggests that most of this growth was driven by the decline in trade barriers as opposed to an expansion of local supply or an increase in overall demand from non-signatory provinces.

E. What are the Gains from Liberalizing Internal Trade?

17. A trade and migration model, with a full set of intersectoral input-output linkages, is used to gauge the impact of lower internal trade costs on real GDP and employment in Canada. This model (see Appendix III for details) builds on the recent work of Tombe and Winter (2018), and Caliendo and Parro (2015) to analyze within-country trade and migration. At its core, the model is an Eaton-Kortum trade model where consumers and businesses allocate their spending across locations to minimize their costs. If trade costs are infinite, there is no trade and all spending is allocated to domestic producers. As trade costs fall, more spending is allocated to the cheapest producers elsewhere and a narrower range of products is produced domestically. This results in higher overall productivity as resources shift to producing goods for which an economy has a stronger comparative advantage. In addition, workers move across provinces (but not across countries) in response to changes in real wages. The results represent comparative static comparisons between two equilibria. We abstract from any adjustment costs or time involved in moving from on equilibrium to another. The results should therefore be seen as a long-run potential gain, as we do not quantify the short-run adjustment costs or how long such an adjustment might take[27].

18. In the model, a province's real GDP per capita increases with interprovincial trade. Sectors that are central to an economy's input-output structure or sectors where the elasticity of trade is low have a stronger effect on a province's overall performance. Specifically, the change in province *n*'s per capita GDP, $\hat{y}_n$, is given by:

$$\hat{y}_n = \prod_{j=1}^{J} \left(\hat{\pi}_{nn}^{j}\right)^{-g^j/\theta^j},$$

[26] See Novy (2011) for details.

[27] Our results are also contingent on the model that we use, and alternative techniques may yield alternative results.

where $\hat{\pi}_{nn}^{j}$ is the change in how much spending is allocated to local producers, g^j is a measure of sector j's "importance" in the supply chain and θ^j is the elasticity of trade.[28] Nationally, Canada's overall real GDP, $\hat{Y}$, depends both on changes to each province's per capita real GDP, $\hat{y}_n$, and on changes in the allocation of employment across provinces, $\hat{L}_n$. Specifically,

$$\hat{Y} = \sum_{n=1}^{N} \omega_n \hat{y}_n \hat{L}_n,$$

where ω_n is a weight of province *n* in Canada's real per capita GDP.

19. The model is calibrated to assess the importance of current trade and to simulate the effects of lower trade barriers. In the first step we assess the welfare gains of current trade flows with existing trade barriers relative to an autarky or no trade counterfactual where trade costs in all 18 sectors becomes prohibitive. In the second step, we analyze the impact of removing all non-geographic trade barriers on GDP, trade and employment. We simulate only changes in outcomes and start from an initial equilibrium that exactly matches observed trade flows. The key production function and consumption parameters are taken directly from Canada's supply-and-use tables for 2015. Finally, two parameters are central to how trade and migration responds to changes in trade costs. First, the estimates of trade elasticities are taken from Caliendo and Parro (2015) for the goods sectors. Following Costinot and Rodriguez-Clare (2014) an elasticity for the service sectors is set to 5. Second, an income-elasticity of migration is set to 1.5, as in Tombe and Winter (2018). This is also consistent with empirical estimates and quantitative simulations in the literature.

Step 1: The Importance of Trade

20. Even with existing barriers, trade is critical for Canada's national and provincial economies. In the counterfactual autarky equilibrium, consumers and businesses allocate all spending to domestically produced goods and services. As a result, average productivity declines. The exercise suggests that trade even if restricted would bring welfare gains relative to autarky. Internal trade increases national real GDP by over 5 percent, external trade by nearly 11 percent, and trade overall by nearly 20 percent (Table 6).

21. The importance of trade for provincial economies varies widely. Internal trade increases real GDP more among smaller provinces than among larger provinces, and especially among Atlantic provinces. Nova Scotia, for example, gains roughly 10 percent from internal trade relative to a counterfactual where only external trade is possible. External trade also increases real GDP more among smaller provinces, except for Prince Edward Island, where internal trade matters more. Combined, the gains for provinces range from a low of 15.4 percent for Ontario to a high of 58.8 percent for Nova Scotia. Overall, larger gains in typically poorer regions implies trade promotes greater equality across provinces—trade lowers the variance of real GDP per worker by 22 percent.

[28] This equation applies in a special case of the model where trade is balanced. See Appendix III for details behind how g^j is calculated.

22. The distribution of employment across provinces is also affected by internal and external trade. Internal trade allows more workers to live in the three northern territories than would otherwise be the case. Moreover, employment in Atlantic provinces and the territories is significantly higher as a result of internal trade. Employment in Prince Edward Island, for example, is nearly 11 percent higher relative to the counterfactual with no internal trade. For the four Atlantic provinces, internal trade raises aggregate employment by over 5 percent. External trade also has implications for the distribution of employment. Western provinces and most Atlantic provinces see gains, while other provinces see declines. Overall, trade tends to sustain higher employment levels in provinces outside Ontario and Quebec. The primary reason for these employment shifts is changes in real incomes. Provinces with above-average gains in real incomes will see employment increases due to immigration while provinces with below-average gains will see lower employment.

Table 6. Canada: Gains from Observed Trade Relative to Autarky, 2015 1/

	Real GDP Per Capita (percentage change)			Employment (percentage change)		
Region	Internal	External	All Trade	Internal	External	All Trade
AB	5.1	11.4	20.8	0.1	0.9	1.3
BC	4.4	13.4	24.2	-1.0	3.6	5.5
MB	8.3	8.8	26.0	4.7	-2.7	7.9
NB	7.2	16.4	36.6	3.1	7.7	21.8
NL	6.9	13.7	26.3	2.5	4.0	8.2
NS	9.6	23.7	58.8	6.5	18.0	52.6
NT & NU	8.7	10.5	28.8	5.2	-0.3	11.4
ON	4.4	9.2	15.4	-0.9	-2.2	-5.4
PE	12.6	9.0	33.4	10.8	-2.4	17.4
QC	5.0	9.8	18.0	-0.2	-1.4	-2.3
SK	6.7	14.1	26.3	2.3	4.5	8.2
YT	8.6	19.0	45.5	5.0	11.4	33.8
Canada	5.1	10.9	19.6	-	-	-

Source: Staff calculations.

1/ The reported changes in real GDP and employment are defined as changes in the observed values relative to the no-trade counterfactual.

Step 2: The Impact of Lower Internal Trade Barriers

23. Lower internal trade costs would increase internal trade volumes and overall economic activity in Canada, especially in smaller provinces. To quantify the impact of lower trade costs on Canada's provincial and national economies, the model is used to simulate the complete liberalization of internal trade, an extreme scenario which represents an upper bound of welfare gains. This is done by removing the measured non-geographic trade costs reported earlier for the 9

goods sectors only.[29] Removing non-geographic internal trade costs increases trade volumes as a share of GDP by roughly 15 percentage points. This would bring internal trade volumes to a level similar to international trade volumes, a situation not seen in Canada since the early 1980s. The effect on economic activity is similarly large. Real GDP per capita would increase by 3.8 percent nationally, with gains as large as 16 percent in Prince Edward Island (Table 7). For the Atlantic provinces, real GDP per worker would increase by 8 percent. The prevalence of widespread significant gains is robust to different elasticity specifications (see Appendix IV).

Table 7. Canada: Gains from Eliminating Non-Geographic Trade Barriers for Goods, 2015

	Real GDP Per Capita (percentage change)			Employment (percentage change)		
Region	Internal	External	All Trade	Internal	External	All Trade
AB	3.2	6.5	8.9	-0.9	0.4	-0.2
BC	2.8	5.7	7.9	-1.5	-0.7	-1.6
MB	7.1	11.4	16.1	4.8	7.4	9.8
NB	6.0	5.6	10.0	3.1	-0.8	1.2
NL	12.8	12.0	21.2	13.3	8.3	17.1
NS	4.8	19.8	22.0	1.4	19.8	18.2
NT & NU	7.5	7.6	13.3	5.3	2.0	5.9
ON	2.9	4.8	7.0	-1.3	-2.0	-2.8
PE	16.2	9.6	22.1	18.4	4.8	18.4
QC	4.6	6.1	9.6	1.0	-0.2	0.7
SK	5.1	5.7	9.6	1.9	-0.7	0.7
YT	6.9	4.2	9.8	4.5	-2.8	1.0
Canada	3.8	6.2	9.1	-	-	-

Source: Staff calculations.

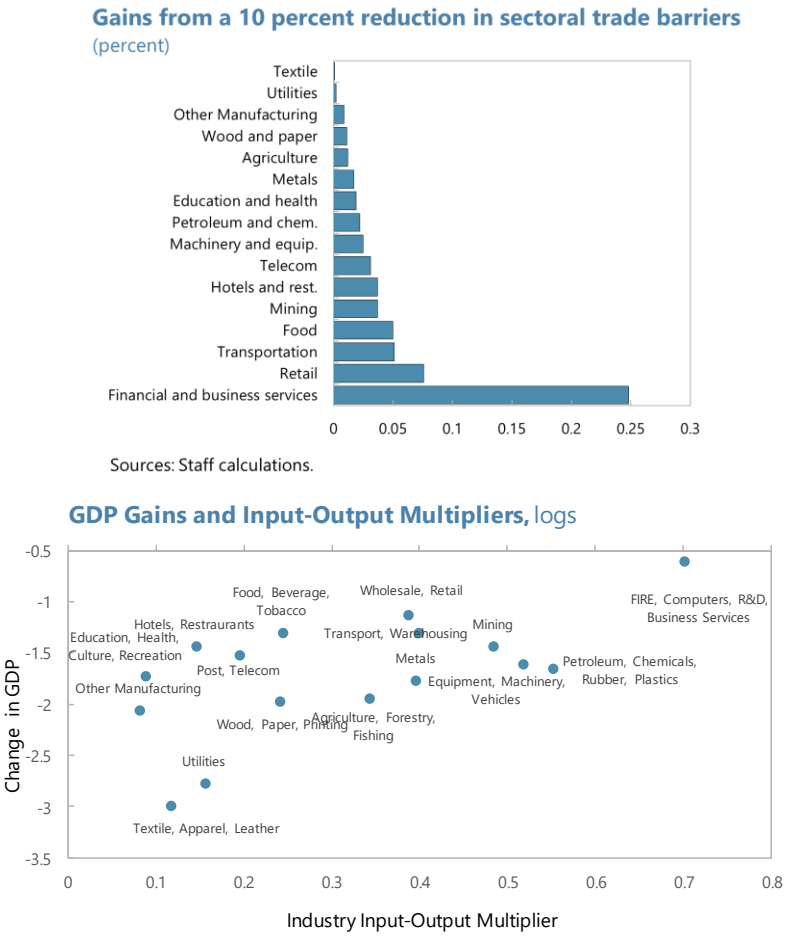
24. Lower internal trade costs also tend to reallocate employment towards provinces that experience large productivity gains from trade. Workers respond to productivity gains and migrate out of provinces where gains are below average (British Columbia, Alberta, and Ontario) to other regions, especially Atlantic provinces, where employment increases by 6 percent overall. These flows are large for some provinces, such as Prince Edward Island and Newfoundland and Labrador, but the aggregate migration flows across all provinces from reducing internal non-geographic barriers represents only 0.8 percent of total Canadian employment.

[29] To measure the effects of lower internal trade barriers versus lower external trade barriers, we separately lower the measured trade costs between provinces (internal trade only) and between each province and the world (external trade only). To simulate the effect only of improving trade flows, we hold unchanged trade cost between region-pairs and sectors where we estimate negative non-geographic trade barriers. Any province with zero production, or zero trade with some other province, in any sector, will continue to have zero production or zero trade in all counterfactuals.

25. Liberalization of the finance, business services, and wholesale and retail sectors produces the largest gains. To gauge the importance of individual sectors in contributing to the aggregate gain in GDP from lower internal trade costs, we simulate the reduction in measured internal trade costs for each individual sector, holding trade costs in all other sectors unchanged. Specifically, we lower measured trade costs by 10 percent in each sector, to ensure comparability across sectors (Figure 2; top panel). Gains from lower internal trade costs are larger in sectors that are important suppliers of intermediate inputs. Reducing trade costs in finance, computers, and business services lead to the largest gains, followed by wholesale and retail activities and transport and warehousing. This reinforces the value of efforts to unify securities regulations across provinces and speaks to the importance of allowing legal, accounting, and other professions to move seamlessly across borders. Since these sectors are the largest suppliers of inputs to other sectors, lower trade costs in these sectors cascade throughout the economy and boost productivity in all other sectors that use these inputs (Figure 2[30]). To be sure, it may be more difficult to liberalize trade in certain service sectors – especially, for example, in education, health, culture and recreation. On the other hand, trade liberalization in sectors such as business services, transportation and warehousing could be achieved with certification harmonization, labor mobility agreements, or harmonized trucking and transport rules.

[30] The bottom panel plots the sector-specific gains to national real GDP (in logs) against a measure of each sector's importance as an input supplier This is the row-sum of the Leontief Inverse Matrix. Intuitively, this measure is proportional to the average amount of sector i's output required to satisfy one dollar of final demand in all other sectors of the economy. It is sometimes referred to as the "total forward linkage" measure.

Figure 2. Canada: Real GDP Gains from Individually Liberalizing Industries



Note: The effect of reducing measured internal trade costs in each sector – one at a time – by 10 percent. The top panel displays the change in national real GDP. The bottom panel displays these gains against each sector's total forward linkage – both on a log scale.

F. Can the Federal Government Secure Free Internal Trade?

26. In theory, yes. Under the 1867 Constitution Act, Section 90 gives the federal authorities the powers to reserve or outright disallow any new provincial legislation that has the effect of inhibiting internal trade[31] and Section 91(2) gives the federal government full control over "trade and commerce". In addition, Section 121 states that goods should be admitted freely across provinces.

[31] This power can only be used within the first year of a provincial law being enacted. Also, Section 90 is not specific to disallowing provincial legislation that has the effect of inhibiting internal trade but to any provincial legislation.

27. But in practice, less likely. Federal government powers over trade intersect with provincial powers granted under other sections of the Constitution Act. For example, Section 92(13) gives provinces control over "property and civil rights".[32] This intersection of powers has been tested several times. In 2011, the Supreme Court ruled that the proposed 2010 Canadian Securities Act[33] was not valid under federal trade and commerce powers and that federal authorities intruded into provincial powers over property and civil rights. In 2018, the Supreme Court ruled in R. *v.* Comeau[34] that New Brunswick was within its rights to impose fines on the transportation of alcoholic beverages into the province.[35] The court noted that Section 121 of the Constitution should be interpreted in historical context and in light of the principle of federalism, which allows for provincial and territorial diversity and provincial regulation of local concerns. Thus, trade restrictions for purposes such as enabling public supervision of the production, movement, sale and use of alcohol were consistent with the Constitution as they reflected the provincial right to govern even if the restrictions had an "incidental" effect on trade.

28. A political, cooperative solution is therefore the only viable solution. Most of the barriers to internal trade are the result of regulatory differences, and harmonizing those regulations requires cooperation among provinces rather than a top-down approach. The Supreme Court's conclusions regarding the 2011 securities reference case noted:

"…the growing practice of resolving the complex governance problems that arise in federations, not by the bare logic of either/or, but by seeking cooperative solutions that meet the needs of the country as a whole as well as its constituent parts. Such an approach is supported by the Canadian constitutional principles and by the practice adopted by the federal and provincial governments in other fields of activities. The backbone of these schemes is the respect that each level of government has for each other's own sphere of jurisdiction. Cooperation is the animating force. The federalism principle upon which Canada's constitutional framework rests demands nothing less."

29. There has been a move toward cooperative federalism and increasing support from governments for a broad reduction in trade barriers in recent years. The renegotiation of the AIT in 2014-2017 (resulting in the CFTA), collaborative messages from the 2018 Council of the Federation meeting of premiers, as well as the December 2018 First Ministers' Meeting all suggest a desire and willingness to take action. The federal, provincial and territorial governments should build on the current consensus and move forward to tackle the remaining restrictions.

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[32] Section 92 gives the provincial legislatures the authority to make laws regarding important economic areas such as starting and running a business, obtaining professional accreditation, ensuring safety and generally any other matters of a "merely local or private nature in the province". The federal and provincial governments have also shared responsibility over specific areas such as immigration, agriculture, old age pension, etc.

[33] Canadian securities markets are regulated by Canada's provincial and territorial governments. The intention of the 2010 Canadian Securities Act was to establish a national securities regulator.

[34] See the 2018 Supreme Court of Canada decision in Her Majesty The Queen v. Gerard Comeau (2018), S.C.C. 15.

[35] New Brunswick's Liquor Control Act limits personal importation to 12 pints of beer and one bottle of alcohol or wine with the primary purpose of public supervision of the production, movement, sale, and use of alcohol within New Brunswick and sustaining a provincial monopoly liquor distributor.

G. Lessons From Countries That Have Undergone Internal Trade Liberalization

30. Mutual recognition was adopted in Australia in 1993 to remove regulatory barriers to the free flow of goods and labor between Australian states and territories. This brought about a more efficient economy (Productivity Commission, 2009), strengthening competition in many industries and benefiting consumers with lower prices and more choices for goods. A single consumer protection law was adopted in 2010 under the authority of the federal government to replace consumer protection laws at individual states and territories. This was a major step towards eliminating all internal trade barriers in Australia.

31. The success of the Australian approach was the result of collaborative federalism and the courts' stance on internal trade barriers. Collaborative federalism towards achieving a single market in the early 1990s was key in eliminating internal trade barriers: the Mutual Recognition Accord of 1992 was endorsed and signed by all first ministers and the Productivity Commission created in 1997 was given resources to study and make recommendations about internal trade. Furthermore, there was greater consensus for cooperative and executive federalism, which led to a gradual transfer of power from the states to the federal government over time (Smith and Mann, 2015). The history of litigation and courts' decisions might also explain why Australia made greater progress in reducing internal trade barriers. Australian courts have often applied Section 92 of the Australian Constitution, which is similar to Canada's Section 121 that free internal trade, to invalidate laws creating internal trade barriers (Smith and Mann, 2015)[36].

32. The European Union (EU) has adopted a more coercive approach to ensuring a single market. The EU's Treaty of Rome prohibits measures "capable of hindering, directly or indirectly, actually or potentially, intra-Community trade". In addition, the EU has issued directives[37] requiring the harmonization of laws between member states and adopted the Mutual Recognition Regulation in 2008 to facilitate the free movement of goods and services.[38] The European Commission provides an important oversight role by reviewing and providing feedback on proposed legislative and regulatory changes prior to their ratification in national and subnational legislatures.

33. The experience of Australia and the EU, nevertheless, cannot be directly translated to Canada. In contrast to Australia, courts in Canada have generally not used Section 121 to eliminate laws creating internal trade barriers. They have argued instead that Section 121 prohibits tariff barriers only[39] and not other impediments to interprovincial trade, or that it should be interpreted based on the historical, legislative and constitutional context in Canada that respects an appropriate

[36] It is important to note that the constitutional division of powers between the federal and state authorities in Australia is different than in Canada.

[37] A directive is a coercive measure which indicates the objectives to be met and sets a period for national governments to adapt their own regulations. Failure to implement the directive can lead to material consequences for a member state.

[38] See Regulation (EC) No 764/2008.

[39] See the 1921 Supreme Court of Canada decision in Gold Seal Ltd. v. Alberta (1921), 62 S.C.R. 424.

balance between federal and provincial powers. For the same reasons, the more coercive approach of the EU may be difficult to envisage in Canada.

H. Is There Public Support for Internal Trade Liberalization?

34. There is overwhelming public support for free internal trade. The surveys of the Canadian Federation of Independent Business (2014) showed that most Canadian firms (87 percent) believe that provincial and territorial premiers should commit to reducing internal trade barriers. Nine in ten small businesses, including several industry associations,[40] think that all firms should have open access to all markets in Canada. More than half of the firms believe that provincial and territorial governments should not protect local businesses from competition in other provinces and territories. A survey conducted by Ipsos Public Affairs (2017) found 89 percent of respondents agree that Canadians should be allowed to bring any legally purchased product from one province to another; nine in ten Canadians say there should be free trade between the provinces "because we are one country." A majority see reducing trade barriers between provinces as being good for consumers (81 percent) and Canadian businesses (77 percent).

I. What can we Expect in the Future: From AIT to CFTA

35. The AIT was an important step forward but its effectiveness in reducing internal trade barriers was limited[41]. The AIT was an intergovernmental trade agreement that came into force in 1995. While it aimed to enhance interprovincial trade by eliminating barriers to the free movement of persons, goods, services and investment within Canada, many restrictions remained. The agreement was narrow in its scope, adopting a positive list approach focused on removing trade barriers in eleven sectors[42]. The AIT also did not have an effective dispute resolution mechanism. In 2015, the AIT was amended to include a dispute resolution mechanism that was enforceable and carried monetary penalties for non-compliance. A measure of success was achieved in public procurement which was made more transparent and open, and labor mobility[43] for regulated occupations was enhanced.

36. After several years of negotiations, a new intergovernmental trade agreement, the CFTA, was established to replace the AIT. The government of Canada, the ten provinces and three

[40] They include the Retail Council of Canada, the Canadian Vintners Association, the Canadian Federation of Agriculture, the Business Council of Canada, and the Canadian Welding Bureau (Senate hearing, 2016).

[41] Moreover, Anderson and Yotov (2008) find no empirical evidence for positive effects of the AIT on interprovincial trade.

[42] They include procurement, investment, labor mobility, consumer protection, agricultural and food products, alcoholic beverages, communications, transportation and environmental protection.

[43] For example, there was a commitment for certificate-to-certificate recognition for labor mobility in Chapter 7 in the 2009 AIT.

territories[44] signed the CFTA on July 1, 2017. Unlike the AIT, the CFTA adopts a negative list approach, where its rules apply automatically to almost all areas of economic activity in Canada, with any exceptions being clearly identified. While the number of exemptions is large, the negative list approach is a significant step forward in enhancing transparency. The agreement also enhances government procurement rules and introduces a regulatory reconciliation process (through the Regulatory Reconciliation and Cooperation Table, RCT) to eliminate duplicate, overlapping and inconsistent regulations. The dispute settlement mechanism from the 2015 AIT amendments was carried forward into the CFTA and strengthened with higher penalties for non-compliance[45]. The agreement is fully harmonized with international agreements to ensure a level playing field for both domestic and foreign firms.

37. However, substantial challenges remain. The list of exceptions is long, itemized in well over 135 pages, and the areas often cited as most affected by internal trade barriers (alcohol, dairy and other farm products, trucking regulations, corporate registry) are part of the list. Despite the RCT, it is relatively easy for governments to opt out of negotiations if they do not have an existing measure to reconcile or if they determine that reconciliation is not a desirable option for their jurisdiction. Progress on labor mobility and professional accreditation is also limited and the Internal Trade Secretariat is insufficiently resourced to study and prepare regular progress reports.

38. Recently, the federal and provincial governments announced that they would tackle key outstanding issues. They are planning to take action to reduce regulatory restrictions related to occupational health and safety[46], transport regulation[47], licensing in agriculture, and corporate registry[48]. They also agreed to address personal use exemption limits for alcohol when crossing provincial/territorial boundaries. Some jurisdictions may eliminate limits entirely, as is now the case in Manitoba,Alberta, Prince Edward Island, Nova Scotia and Saskatchewan. Moreover, in January 2019, the Safe Food for Canadians Regulations came into effect, and in April 2019, the federal government made the National Building Code available for free online. More recently, two reconciliation agreements (on organic labelling for aquaculture products and inspection requirements for produce) have been reached.

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[44] The CFTA allows other regional free trade agreements only if they liberalize trade, investment, labor mobility beyond the level achieved by the CFTA.

[45] Penalties for non-compliance were raised for the largest jurisdictions to a maximum of $10 million. The fines collected would be deposited into an internal trade fund and not as a compensation to the complainant.

[46] Provinces, territories and the federal government have agreed to adopt and recognize common standards for first aid kits, head protection, eye and face protection, hearing protection, foot protection, and personal floatation devices and life jackets.

[47] Provinces, territories and the federal government have agreed in principle to allow the use of wide-base single tires at weight parity with conventional dual tires on all major trade routes in Canada by the end of 2019.

[48] A new multi-jurisdictional registry access system (MRAS) is being developed that will enable streamlined registration and mutual recognition for multi-jurisdictional businesses. The system is expected to be in operation by 2020.

J. Summary and Policy Messages

39. While there is evidence of improvements in regional integration, significant trade barriers remain. The average non-geographical trade barrier is about 20 percent, ranging from 7 percent for textiles, petroleum and chemicals to over 27 percent for heavier metals, food products and other manufacturing goods. Alberta, British Columbia, and Ontario have the lowest non-geographic barriers. In contrast, Manitoba, Prince Edward Island, Nova Scotia, Yukon, and Newfoundland and Labrador have the highest non-geographic barriers.

40. Reducing the cost of internal trade barriers benefits the whole economy. Our results suggest that removing non-geographic trade barriers would increase trade volumes to a level similar to international trade volumes. Real GDP per capita would increase by 4 percent nationally if trade in goods was fully liberalized. Workers would respond to productivity gains and migrate out of provinces where gains are below average (British Columbia, Alberta, and Ontario) to other regions, especially Atlantic provinces where employment would increase by 6 percent. Reducing barriers in the finance, business and insurance sectors would most benefit the economy, as they are highly interconnected with other parts of the economy, reinforcing the value of efforts to unify securities regulations across provinces and enhance labor mobility.

41. With much at stake, federal, provincial and territorial governments should make reducing internal trade barriers their common priority. Internal trade barriers are a longstanding issue and nothing short of a sustained and concerted collective effort will be necessary to break down barriers that are impeding Canadian businesses from competing on a level playing field and scaling-up. Easier access to the entire Canadian market could also attract more investment to Canada. A "coalition of the willing" could be one way to accelerate progress.

42. The CFTA signed in 2017 provides a platform for cooperation, but there are several problematic aspects that need to be resolved.

NTBs should be clearly identified and progress towards removing them should be assessed at regular intervals. Targets for a reduction in the number of exemptions to CFTA should be explicitly set out in future negotiations.

- The CFTA process of regulatory reconciliation could be more effective. It is administratively burdensome, negotiations are protracted, and a province can opt out of the process[49]. A "comply or explain" approach would ensure better accountability and accelerate the work on harmonization of regulations.

- The Secretariat should be sufficiently resourced (with budget and full-time employees) to assess and communicate progress on trade liberalization, including publishing an annual report on

[49] The opt out must be transparently listed on the CFTA's website.

goals set and progress in achieving them. The Secretariat would assume the responsibilities of ad hoc committees and working groups to initiate, develop, and monitor policy reforms.

- Although penalties for non-compliance were raised when the CFTA came into force in 2017, they still do not fully reflect the magnitude of the economic impact. Penalties should be calibrated to better distinguish large barriers from small.
- There is scope for recognizing unilateral provincial action. Recognizing the validity of extra-provincial certifications, standards, and registrations can benefit a single province even if the recognition is not reciprocated. Under such a "national recognition" regime, a province would consider a certification from another province as deemed-compliant with its own.

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Appendix I. Estimating the Costs of Internal Trade Barriers

1. We use the Head-Ries index as our primary measure of trade barriers. Head and Ries (2001) and Novy (2013) demonstrate that this index summarizes average trade costs in a broad range of models and is therefore a reasonable measure of unobservable trade costs. The Head-Ries index for each sector j and pair of regions n and i is defined as:

$$\bar{\tau}^{j}_{ni,t} \equiv \sqrt{\frac{\tau^{j}_{ni,t}}{\tau^{j}_{nn,t}}\frac{\tau^{j}_{in,t}}{\tau^{j}_{ii,t}}} = \left(\sqrt{\frac{\pi^{j}_{nn,t}}{\pi^{j}_{ni,t}}\frac{\pi^{j}_{ii,t}}{\pi^{j}_{ni,t}}}\right)^{1/\theta_j}$$

where $\tau^{j}_{ni,t} \geq 1$ is the iceberg cost of importing good j from region i into region n at time t, θ_j is the cost elasticity of trade for the sector, and $\pi^{j}_{ni,t}$ is the share of spending region n allocates to production from region i at time t. That is $\pi^{j}_{ni,t} = X^{j}_{ni} / \sum_i X^{j}_{ni'}$ where X^{j}_{ni} reflects imports of region n from region i and X^{j}_{nn} stands for local goods consumption. Intuitively, the index reflects trade costs of trading across regions relative to trading within each region. In our application, the index reflects trade barriers from trading between Canadian provinces, the United States, and the Rest of the World.

2. Part of these estimated trade barriers stem from geographical factors. To account of for these, we regress the Head-Ries index on population weighted distances and an indicator of whether regions share a contiguous border. That is,

$$\ln\left(\bar{\tau}^{j}_{ni,t}\right) = \alpha^{j}_{1} Distance_{ni} + \alpha^{j}_{2} Neighbor_{ni} + \beta^{j}_{1} Intra_{ni,t} + \beta^{j}_{1} Inter_{ni,t} + \gamma^{j}_{n,t} + \eta^{j}_{i,t} + \epsilon^{j}_{ni,t}$$

Where $Distance_{ni}$ is our distance measure, $Neighbor_{ni}$ is the shared-border indicator, $Intra_{ni,t}$ and $Inter_{ni,t}$ are indicators of intra-provincial and inter-provincial trade interacted by year, and $(\gamma^{j}_{n,t}, \eta^{j}_{i,t})$ are exporter and importer fixed effects interacted with year. Coefficients for geographic indicators are reported in the main text. Moreover, non-geographic trade costs are defined as:

$$\ln\left(\widehat{\bar{\tau}^{J,NG}_{ni,t}}\right) \equiv \ln\left(\bar{\tau}^{j}_{ni,t}\right) - \left(\widehat{\alpha^{J}_{1}} Distance_{ni} + \widehat{\alpha^{J}_{2}} Neighbor_{ni}\right)$$

Appendix II. Data

1. The sample include all Canadian provinces and territories, the United States and the rest of the world (ROW). All variables are classified into 18 sectors, 9 goods sectors and 9 service sectors, to match different sources of data for trade, production, expenditure in Canada, the U.S. and the ROW. The data sources used are as follows:

- **Trade data.** Bilateral interprovincial trade data during 1992-1996 come from Statistics Canada, table 12-10-0085-01, which was replaced by table 12-10-0086-01 and table 12-10-0088-01 for data between 1997-2006 and 2007-2015. Aggregated international trade data are also obtained from these three tables. The product categories are based on the Supply and Use Product Classification from Statistics Canada. Data on merchandise trade between US and Canadian provinces come from Statistics Canada, table 12-10-0099-01, which records commodity flow based on Harmonized Commodity Description and Coding System (HS). Service trade data between US and Canadian provinces are provided by Statistics Canada. Trade between provinces and the ROW are derived by subtracting US trade flow from the total international trade flow. Data on trade between US and ROW are obtained from USA Trade Online, where US trade flows are reported based on the same HS categories.

- **Production.** Provincial production is taken from Statistics Canada, table 12-10-0086-01, table 12-10-0088-01 and 12-10-0085-01. US and ROW production data is derived from Eora's world input-output tables. Eora provides a harmonized 26-sector classification derived from different national account categories used all over the world.

- **Expenditure.** Provincial expenditure data is based on the same tables from Statistics Canada that provided production and interprovincial trade data. US and ROW's expenditure was calculated by adding international imports and subtracting international exports from the gross output.

- **Distance data** is calculated based on population-weighted centroids by province, U.S. and the ROW separately. Specifically, we use the spatial distribution of global population from the Global Rural-Urban Mapping Project (Version 1) Settlement Points data for the year 2000. This data is produced by the Center for International Earth Science Information Network at Columbia University, CUNY Institute for Demographic Research, IFPRI, the World Bank, and CIAT. We aggregate using the population data, and determine the population-weighted longitude and latitude coordinate for each Canadian province and territory, the U.S., and the ROW. We then calculate the orthodromic distance between these points. This measure of distance does not reflect the differences in transportation costs per kilometer inherent in certain trade pairs within Canada. For example, trade with territories is costlier per kilometer than trade between provinces, and trading across the Rocky Mountains is more costly than across the Prairies.

- Sectoral classifications from different datasets are reclassified into the following categories:

Industry	Supply and Use Product Codes (2007-2015)	HS Code	Eora Sector	NAICS Code
Agricultural products, fishing, forestry	M111B, M112A, M11D0, M11E0, M1140, M1150	01-15	Agriculture, Fishing	11
Food, beverage, tobacco	M31C0, M312A	16-24	Food & Beverages	311FT
Mining	M21B0, M2122, M2123, M2130, M21A0	25-27	Mining and Quarrying	21
Textile, apparel, leather products	M31D0	41-43, 50-67	Textiles and Wearing Apparel	313TT, 315AL
Wood and Paper, printing	M3210, M3220, M3230, M51E0	44-49	Wood and Paper	321, 322, 323, 511
Petroleum, Chemical and Non-Metallic Mineral Products, rubber plastics	M3240, M3250, M3260, M3270	28-40, 68-71	Petroleum, Chemical and Non-Metallic Mineral Products	324-327
Metals and metal Products	M3310, M3320	72-76, 78-83	Metal Products, Recycling	331, 332
Electrical and Machinery	M3330, M334C, M3350	84-85, 90-91, 93	Electrical and Machinery	333-335
Transport Equipment	M336A, M3363,	86-89	Transport Equipment	3361MV, 3364OT
Other Manufacturing including furniture	M3370, M3B00,	92, 94-99	Other Manufacturing	337, 339
Utilities	M2200		Electricity, Gas and Water	22
Construction	M23A0, M23B0, M23C0, M23D0		Construction	23
Wholesale and retail trade	M4100, M4A00, F3000		Maintenance and Repair, Wholesale Trade, Retail Trade	42, 44T
Hotels and Restraurants	M7200		Hotels and Restraurants	721
Transportation and warehousing	M4B00		Transport	48TW
Post and Telecommunications	M5170		Post and Telecommunications	513
Finacial Intermediation, RE, insurance, computer, R&D, and other Business Activities	M51D0, M52C0, M5F00, M53D0, M53C0, M541E, M5E00, M5417, M5G00		Finacial Intermediation and Business Activities	514, FIRE, PROF
Government services	M9B00, G6100, G6200, G9110, G9120, G9130, G9140		Public Administration	G
Education, Health and Other Services incl Recreational, cultural and sporting activities	M6100, M6200, M7100, M8100, M9A00, F1000, F2000, N0000, P1000		Education, Health and Other Services, Private Households, Others	512, 6, 7, 81

Appendix III. Estimating the Impact of Internal Trade Barriers: the Model

1. To estimate the effect of internal trade barriers on economic activity in Canada and its provinces, we build on the model developed by Tombe and Winter (2018). At its core, this is a multi-sector Eaton and Kortum (2002) model featuring intersectoral linkages and interprovincial migration. In addition, we follow Caliendo and Parro (2015) and solve the model in the so-called "Exact Hat Algebra" form. This eases model calibration and simulation substantially. Specifically, it allows us to simulate the counterfactual responses of GDP, employment, wages, prices, and so on, to eliminating the policy-relevant (non-geographic) trade costs starting from an initial equilibrium that exactly matches observed data on interprovincial and international trade. We provide a broad overview of the model structure here, but leave detailed derivations to the three papers just cited.

2. The overall environment is structured to cleanly map onto readily available multi-region input-output data, yet still allow for rich and flexible counterfactual experiments. There are N regions, each with L_n individuals that work and consume. They consume a set composite goods, one from each of J sectors, and individual utility is given by

$$U_n = \prod_{j=1}^{J} \left(C_n^j\right)^{\beta^j},$$

where β^j, in equilibrium, is share of total consumer expenditures allocated to sector j. The consumption composite is a CES aggregate across a continuum of varieties produced by heterogeneous firms within each sector. A producer of a specific variety v requires labour inputs $l_n^j(v)$ and intermediate inputs $q_n^{jk}(v)$ to generate output according to

$$y_n^j(v) = \varphi_n^j(v) l(v)^{\phi^j} \left[\prod_{k=1}^{J} q_n^{jk}(v)^{\sigma^{jk}}\right],$$

where $\varphi_n^j(v)$ is the total factor productivity of this specific producer. Variation in productivity leads to variation in production costs, and therefore scope for gains from trade. Consumers seek out the lower cost producer of any given variety, and can trade across regions subject to iceberg costs $\tau_{ni}^j \geq 1$ whereby τ_{ni}^j must be shipped for one unit to arrive.

3. Abstracting from the technical derivations, the implies an equilibrium share of expenditures that consumers in each region n allocate to goods from sector j that are produced in region i as a function of productivity (A_i^j), trade costs (τ_{ni}^j), prices (P_n^j), and production costs

$$\pi_{ni}^j \propto \left(\frac{\tau_{ni}^j c_i^j}{P_n^j A_i^j}\right)^{-\theta^j},$$

where θ^j is the trade-cost elasticity of trade, A_i^j is a measure of fundamental productivity in region i to produce sector j goods, τ_{ni}^j is the cost of imported sector j goods from region i into region n, P_n^j is the average price of sector j goods in the importing region n, and c_i^j is the cost of an input bundle in region i used to product sector j goods. Specifically, given the production function described earlier,

$$c_i^j \propto w_i^{\phi^j} \left[\prod_{k=1}^{J} \left(P_i^k \right)^{\sigma^{jk}} \right]$$

where ϕ^j is the value-added share in sector j (which we assume is common across regions) and σ^{jk} is the share of total spending on inputs by sector j on intermediate inputs from sector k. These parameter values are calibrated to precisely match the input-output data for Canada in 2015 using Statistics Canada data table 36-10-0001-01, aggregated to correspond with the 18 broad sectors used in our analysis. Finally, average prices depend on trade costs, production costs, and productivity across all regions according to

$$P_n^j \propto \left[\sum_{i=1}^{N} \left(\frac{\tau_{ni}^j c_i^j}{A_i^j} \right)^{-\theta^j} \right]^{-\frac{1}{\theta^j}}.$$

4. These three equations describe the key relationships between trade costs and trade flows. One can show that trade flows, prices, and productivity affect real wages for workers in each region and sector according to

$$\frac{w_n}{P_n^j} \propto A_n^j \left(\pi_{nn}^j \right)^{-\frac{1}{\theta^j}} \left[\prod_{k=1}^{J} \left(\frac{w_n}{P_n^k} \right)^{\sigma^{jk}} \right].$$

5. Taking logs and collecting the input-output coefficients σ^{jk} into the standard Direct Requirements Matrix A, one can use this equation to map changes in trade shares $\log(\hat{\pi}_{nn}^j)$ to changes in real wages $\log(\hat{w}_n / \hat{P}_n^j)$, where hats relative changes, according to

$$W = \Pi^{\mathrm{T}} (I - A)^{-1},$$

where W is the $N \times J$ matrix of (log) real wage changes for each region and sector, Π is the $N \times J$ matrix of changes in home-shares $-\log(\hat{\pi}_{nn}^j)/\theta^j$, and $(I - A)^{-1}$ is the standard Leontief Inverse matrix common to models with complex input-output linkages. This result implicitly holds fundamental productivity A_n^j fixed in our counterfactuals of changes in trade costs.

6. This expression reveals two important channels for how trade costs affect real wages. First, lower trade costs will decrease the share of spending allocated to home produced goods ($\hat{\pi}_{nn}^j < 1$). This will increase average labour productivity in sector j and region n as consumers and business shift their spending to more productive producers in other locations, away from relatively

less productive domestic producers. Second, productivity gains in one sector cascade through the economy's complex web of intersectoral linkages. This is captured by the Leontief Inverse matrix.

7. Changes in trade shares are induced by changes in trade costs, production costs, and prices according to,

$$\hat{\pi}_{ni}^{j} \propto \left(\hat{\tau}_{ni}^{j}\hat{c}_{i}^{j}/\hat{P}_{n}^{j}\right)^{-\theta^{j}},$$

where the change in trade costs are exogenous and reflect the estimated costs described in the chapter. Changes in production costs and prices are solved as equilibrium counterfactual changes that solve

$$\hat{P}_{n}^{j} \propto \left[\sum_{i=1}^{N} \pi_{ni}^{j}\left(\hat{\tau}_{ni}^{j}\hat{c}_{i}^{j}\right)^{-\theta^{j}}\right]^{-\frac{1}{\theta^{j}}}.$$

and

$$\hat{c}_{i}^{j} \propto \hat{w}_{i}^{\phi^{j}}\left[\prod_{k=1}^{J}\left(\hat{P}_{i}^{k}\right)^{\sigma^{jk}}\right],$$

given changes in trade costs, initial trade shares $\pi_{ni'}^{j}$ which are from data, and wage changes, which are solved endogenously within the model. Specifically, counterfactual changes in wages are implied by changes in global expenditures and revenue. We do not report the fully algorithm to solve for wages here. Intuitively, given an initial guess for wage changes, solve for the counterfactual production costs, price, and trade share changes. Together, these imply counterfactual changes in sales in each sector in each region. And changes in a sector's total payments to labor are proportional to changes in sales. Wages are then inferred from the change in total payments to labor, given a counterfactual distribution of employment, which we turn to next.

8. Our model allows workers to not only move across sectors but also across regions. Though workers can reallocate across sectors within a region at zero cost (which is why wages equalize across sectors) they face costs of migrating across regions. In addition, following Tombe and Winter (2018), workers differ in their individual preferences for different locations. Some prefer living in one province, all else equal, while others prefer living in a different province. The degree of preference heterogeneity across individuals will determine how sensitive workers are to changes in real incomes across locations. That is, workers will choose to live in the region offering the higher real incomes, net of migration costs, adjusted for individual preferences. Let $\hat{P}_n$ denote the change in the aggregate price index of region n, which, given the structure of individual utility, $\hat{P}_n = \prod_{j=1}^{J}\left(\hat{P}_{n}^{j}\right)^{\beta^{j}}$ is simply the weighted (geometric) average across $\hat{P}_{n}^{j}$. With this price index in hand, real wage changes determine the counterfactual change in employment in each region $\hat{L}_n$ according to

$$\log\left(\hat{L}_n\right) \propto \kappa \cdot \log\left(\frac{\hat{w}_n}{\hat{P}_n}\right),$$

where κ is the income-elasticity of migration, which itself is determined by the underlying heterogeneity in worker preferences across location. The constant of proportionality in the above equation ensures employment shares across all provinces sum to one. Migration is restricted to within-Canada moves only; that is, international migration flows are not modelled here.

9. It remains to specify how we calculate real GDP changes that we report in the chapter. A province's aggregate real GDP Y_n is the aggregate real wages across sectors. Thus, we can use the vector of utility weights β to aggregate the matrix W into a vector of welfare changes,

$$Y = \Pi^{\mathrm{T}}(I - A)^{-1}\beta.$$

10. The vector $(I - A)^{-1}\beta$ collects a measure of each sector "importance" for the national economy, each element of which corresponds to g^j used in the text. Specifically, g^j is the elasticity of aggregate productivity with respect to sector j's productivity.

Nationally, Canada's overall real GDP depends on each province's real GDP and the allocation of workers across provinces. Changes in national real GDP are given by,

$$Aggregate\ Real\ GDP\ Change = \sum_n \omega_n \hat{L}_n \hat{U}_n,$$

where ω_n is province n's initial share of national nominal GDP.

11. Note that we do not incorporate observed trade imbalances into the model. This eases the model expressions above, and none of the quantitative results reported in the text meaningfully depend on whether we allow for trade imbalances or not. Aggregate gains from internal trade, for example, are 5.35% in a model where exogenous trade imbalances match the observed trade surplus to GDP ratios in the initial equilibrium. This compares to the 5.18% gains reported in the chapter.

Appendix IV. Robustness of the Results to Alternative Elasticities

1. Our measure of trade costs, and the gains from their reduction, depends on how sensitive trade flows are to trade costs. This trade-cost elasticity of trade flows is summarized in the model by the parameter θ^j. In our baseline results, we adopt the elasticities estimated by Caliendo and Parro (2015), although a range of alternative estimates exist. For example, Bemrose et al. (2017) estimate an aggregate elasticity across all goods sectors of $\theta = 6.4$. To ensure our main results are not biased by the elasticity values we use, we report here our main results under a range of alternative values from $\theta = 4$ to $\theta = 8$ (Table 1).

2. Our baseline results are conservative and not biased upward on account of the specific elasticity values we use. We find that lower elasticities result in larger gains from trade liberalization – which is a well-known property of this class of models. If goods-sector elasticities are a uniform $\theta = 8$, which is at the high-end of the generally accepted range in the literature, aggregate welfare gains from lowering internal trade costs are 3.2 percent. Our baseline results suggest gains of 3.8 percent. For a lower elasticity of $\theta = 4$, aggregate gains exceed 7.3 percent.

Table1. Gains from Eliminating Non-Geographic Internal Barriers for Goods, 2015

	Real GDP Per Capita (percentage change)			Employment (percentage change)		
Region	$\theta = 4$	$\theta = 6.5$	$\theta = 8$	$\theta = 4$	$\theta = 6.5$	$\theta = 8$
AB	6.0	3.8	2.8	-2.1	-1.3	-0.8
BC	6.0	3.8	2.7	-2.1	-1.4	-0.9
MB	13.0	8.3	5.9	7.7	5.3	3.8
NB	10.9	6.9	4.9	4.7	3.2	2.3
NL	20.7	13.2	9.0	19.0	12.4	8.3
NS	10.8	6.8	4.7	4.6	3.1	1.9
NT & NU	12.7	8.1	5.6	7.4	4.9	3.3
ON	5.9	3.6	2.6	-2.3	-1.6	-1.1
PE	27.4	17.8	12.2	29.0	19.3	13.2
QC	8.9	5.6	3.9	1.9	1.3	0.8
SK	9.8	6.2	4.3	3.2	2.1	1.4
YT	13.0	8.2	5.8	7.8	5.1	3.6
Canada	7.3	4.6	3.2	-	-	-

Source: Staff calculations.