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INTERNATIONAL MONETARY FUND

CANADA

Selected Issues

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Approved by the Western Hemisphere Department

February 1, 2005

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PART I: REAL SECTOR ISSUES

I. FACTORING IN CANADIAN CYCLES[1]

1. ***Canada's recent economic history illustrates the important role played by external as well as domestic macroeconomic disturbances***. Canada's economy slowed in 2001 because of the global slowdown, although by less than in many other countries. In 2003, the recovery was interrupted by a series of shocks that moderated growth (on the external side, an appreciation of the Canadian dollar and a case of mad cow disease that constrained agricultural exports, on the domestic side a SARS outbreak and forest fires). Growth rebounded in 2004, partly a result of strong global commodity demand, but further recent appreciation of the Canadian dollar has led to concerns about prospects for 2005.

2. ***While previous studies have documented the importance of U.S. real shocks on Canadian business cycles, further work is needed to analyze the economy-wide effects of external shocks***. For instance, IMF (2004) concluded that the synchronization of real output, consumption and investment fluctuations between Canada and the United States has increased in the last two decades. Other work using vector autoregression (VAR) techniques on a small set of Canadian and foreign variables has also concluded that developments in the United States have strong influences on real activity and nominal variables in Canada (Schmitt-Grohé, 1998; Cushman and Zha, 1996; Burbidge and Harrison, 1985). These findings naturally lead to a question about the transmission channels through which U.S. and other external shocks are impacting on the Canadian economy. Empirical analysis focusing on this question is presented in this paper, using recent developments in dynamic factor models for a comprehensive and broad-based analysis of the role of domestic and external shocks in Canada.

3. ***Compared to VARs, dynamic factor analysis has a number of advantages***:

- ***A wider set of series can be analyzed***. The number of variables that can be included in a VAR is limited by the need to include lagged values of all series in the estimation. Factor analysis, in contrast, allows a wider range of series to be analyzed, allowing for a more comprehensive analysis of economic fluctuations.

- ***The number of shocks is determined by the data***. In VAR models, the number of disturbances is by definition equal to the number of series in the estimation. In factor analysis, the number of shocks is determined statistically. In addition, the precision with which factors are estimated can be used to assess their relative importance over time.

- ***Factor analysis provides more information on the disturbances***. Factor analysis and VARs use similar techniques to identify shocks. In contrast to VAR estimation,

[1] Prepared by Alejandro Justiniano.

however, convergence diagnostics in the estimation of factor models can be used to check if the identifying restrictions are valid.[2]

- ***Factor models provide relatively efficient forecasts***. The internal dynamics of the factors and their effects across series can be used to project likely future developments in the economy. By summarizing the information contained in a large number of series, forecasts based on dynamic factor models can outperform those obtained from VARs.[3]

A. Factor Analysis

4. ***In contrast to recent work on the international transmission of shocks, this study analyzes the effects of multiple shocks with a flexible specification of dynamics***.[4] Extending the earlier work of Gregory, Head, and Raynauld (GHR, 1997) and Kose, Otrok, and Whiteman (KOW, 2003), this paper uses dynamic factors to examine multiple domestic and external shocks affecting the Canadian economy. Moreover, a flexible specification of dynamics allows the factors to affect series contemporaneously and with one lag. Therefore, the analysis can account for spillover effects.[5]

5. ***The factor model used here assumes that each series can be described using a small number of factors with series-specific dynamics plus an error term***. For example, consider the case of two U.S. and two Canadian series labeled $y^{US1}, y^{US2}, y^{CN1}$ *and* y^{CN2}. Assume these series are driven by two external and two domestic factors labeled f^{E1}, f^{E2}, f^{D1} *and* f^{D2}, that affect the series both contemporaneously and with one lag.[6] Then the model is:

[2] Convergence diagnostics in the estimation can indicate problems with the identifying assumptions. Note that it is also possible to test restrictions in over-identified VARs.

[3] Indeed, recent academic research suggests that factor models provide gains in the accuracy of forecasts of the data they describe, relative to small scale VARs and other methods. See for instance Stock and Watson (2002).

[4] Much recent work in this field uses principal components to analyze the transmission of shocks across real GDP series. See, for instance, Bowden and Martin (1996), Lumsdaine and Prasad (2003), Melek-Mansur (1999), and Helbling and Bayoumi (2003). This partly reflects recent advances in estimation techniques (Stock and Watson 1998, Forni *et al.*, 2001, and Kim and Nelson, 1999).

[5] The specification of dynamics is, consequently, similar to the one preferred by Kaufman (2000) for the analysis of European business cycles.

[6] Of course, the simplicity of this example does not highlight one of the greatest advantages of factor models: working with several (possibly hundreds of) series driven by a few common shocks.

$$\begin{pmatrix} y^{US1}(t) \\ y^{US2}(t) \\ y^{CN1}(t) \\ y^{CN2}(t) \end{pmatrix} = A_0 \begin{pmatrix} f^{E1}(t) \\ f^{E2}(t) \\ f^{D1}(t) \\ f^{D2}(t) \end{pmatrix} + A_1 \begin{pmatrix} f^{E1}(t-1) \\ f^{E2}(t-1) \\ f^{D1}(t-1) \\ f^{D2}(t-1) \end{pmatrix} + \begin{pmatrix} \eta^{US1}(t) \\ \eta^{US2}(t) \\ \eta^{CN1}(t) \\ \eta^{CN2}(t) \end{pmatrix}$$

where $\eta(t)$ is a series-specific error and the matrices of coefficients are given by

$$A_s = \begin{bmatrix} \alpha_s^{US1,E1} & \alpha_s^{US1,E2} & \beta_s^{US1,D1} & \beta_s^{US1,D2} \\ \alpha_s^{US2,E1} & \alpha_s^{US2,E2} & \beta_s^{US2,D1} & \beta_s^{US2,D2} \\ \alpha_s^{CN1,E1} & \alpha_s^{CN1,E2} & \beta_s^{CN1,D1} & \beta_s^{CN1,D2} \\ \alpha_s^{CN2,E1} & \alpha_s^{CN2,E2} & \beta_s^{CN2,D1} & \beta_s^{CN2,D2} \end{bmatrix} \text{ for s=0,1}$$

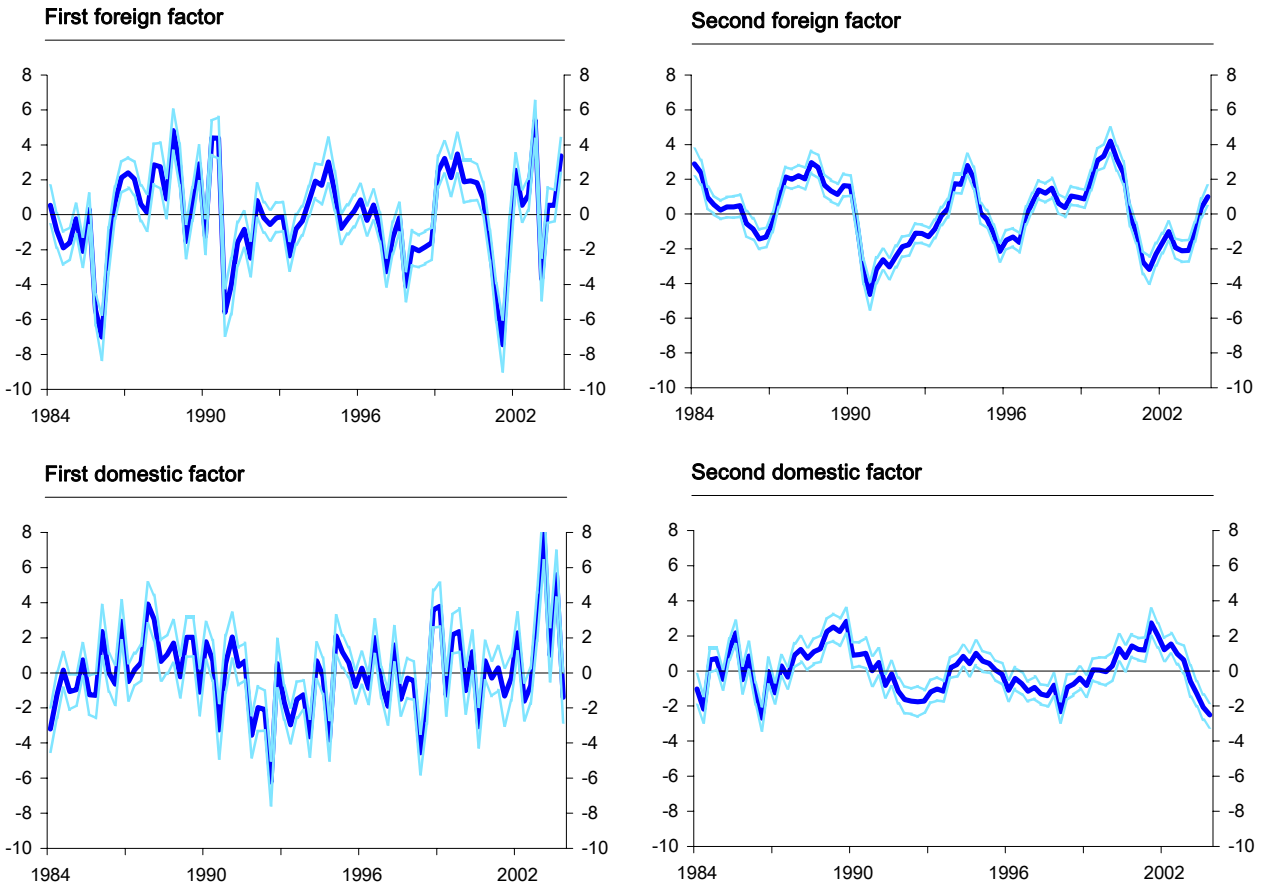
6. ***Factors and coefficients are provided as output of the estimation process, based on a number of identifying restrictions***. Factors are identified by assuming that they are orthogonal both to each other and to the series-specific error terms, and by exclusion restrictions similar to those used in VARs. For example, this paper assumes that Canada is a small open economy, so that external factors affect economic variables in both the United States and Canada, and domestic factors affect only Canadian series. In the example above, this implies $\beta_s^{US,D1}$ and $\beta_s^{US,D2}$ =0 for the U.S. series both in the contemporaneous and lagged coefficients (s=0,1). In addition, the first external factor is assumed to affect the first U.S. series contemporaneously, whereas the second external factor only impacts with a lag (i.e., $\beta_0^{US1,E2} = 0$). A similar assumption applies with respect to how the domestic factors affect the two Canadian variables.

B. Results

7. ***To provide a comprehensive description of economic interactions within and across the United States and Canada, a large number of variables is employed in the analysis***. The estimation uses a panel of 44 quarterly series from early 1984 to early 2004, comprising world prices for oil and other commodities, 18 U.S. real and nominal series, and 24 real and nominal Canadian variables.[7] All series except interest rates are included in terms of their logarithms. Real variables are detrended by calculating deviations from a Hodrick-Prescott trend (with the standard smoothing factor of 1,600), while prices and monetary aggregates

[7] This implies that the models and matrices described on the previous page would each consist of 44 rows. The U.S. and Canadian series comprise main national accounts aggregates (real GDP, consumption, investment, government consumption, exports, and imports), other measures of real activity (industrial production, unemployment, hours worked, labor productivity), prices at different stages of production, interest rates, other financial aggregates, and, in the case of Canada, real exchange rates, prices of exports and imports, and price indices for oil and non-oil commodities.

Figure 1. Factors and Posterior Deciles
(thin lines show tenth and ninetieth percentiles)



Source: Fund staff calculations.

are measured as rates of change (i.e. the change in the logarithm). Further details and sources for the dataset and detrending methods are provided in the Appendix.[8]

8. ***Bayesian analysis resulted in a preferred model including factors that broadly reflect international oil prices, the U.S. cycle, the exchange rate, the non-oil producer and commodity prices, and a Canadian cycle***. This model—involving two external and two "domestic" factors (one of which is associated with the exchange rate, non-oil commodity prices, and producer prices)—resulted in the largest Bayes' Factor out of a wide range of

[8] For the estimation, the data were also standardized, as it is customary in factor analysis, to prevent giving undue weight to the most volatile components in the data.

estimated models.[9] The results also indicate that the factors follow an autoregressive process with three lags, implying potentially quite complex dynamics, and that the factors affect the series contemporaneously and with a one-quarter lag.[10]

Table 1. Variance Decompositions for the United States from a Factor Model with Two External and Two Domestic Factors

Series	Transformation 1/	External Factor 1 Median	External Factor 2 Median
US Producer price index intermediate goods	LD	0.82	0.01
US Industrial production index	LDHP	0.03	0.65
US Unemployment rate	DHP	0.02	0.26
US Shares price index (nominal)	LD	0.07	0.04
US GDP	LDHP	0.01	0.58
US Consumption	LDHP	0.03	0.25
US Investment	LDHP	0.01	0.23
US Government	LDHP	0.04	0.05
US Exports (goods)	LDHP	0.01	0.14
US Imports (goods)	LDHP	0.01	0.51
US Hours	LDHP	0.07	0.33
US Labor productivity	LDHP	0.02	0.32
US Capacity utilization rate	DHP	0.03	0.71
US CPI (all goods)	LD	0.48	0.03
US Producer price index finished goods	LD	0.68	0.08
US Unit labor costs	LD	0.05	0.10
US Federal funds rate	D	0.15	0.45
US M2	LD	0.08	0.06
World price of oil (non-Opec countries)	LD	0.65	0.03
World commodity price index	LD	0.17	0.11

Source: Fund staff calculations.
1/ D = first difference, LD = log of first difference, DHP = deviation from HP trend, LDHP = log of deviation from HP trend

9. ***The factors are estimated with fairly narrow error bands, although a widening of the bands over time suggests that the Canadian cycle may be playing a diminishing role*** (Figure 1). Decompositions that analyze the relative contribution of each factor to fluctuations in individual series, as well as examination of plots of the factors, suggest that external and exchange rate disturbances play a significant role in explaining Canadian fluctuations (Tables 1 and 2). That said, the explanatory power of each factor varies

[9] In the Bayesian setting adopted here, the Bayes' Factor (i.e., the ratio of the posterior model probabilities) corresponds to the ratio of marginal likelihoods. See Kass and Raftery (1995) for an overview of Bayes' factors; Geweke (1999) for the method used here to compute the marginal density; and Lopes and West (2004) and Justiniano (2004) for a discussion of these techniques in factor analysis.

[10] Formal statistical methods did not validate additional lags.

Table 2. Variance Decompositions for Canada from a Factor Model with Two External and Two Domestic Factors

Series	Transformation 1/	External Factor 1 Median	External Factor 2 Median	Domestic Factor 1 Median	Domestic Factor 2 Median
CDN Real exchange rate	LD	0.02	0.03	0.53	0.01
CDN GDP	LDHP	0.03	0.42	0.01	0.47
CDN Industrial production index	LDHP	0.03	0.48	0.01	0.38
CDN Nominal exchange rate	LD	0.04	0.04	0.76	0.01
CDN Labor productivity	LDHP	0.02	0.12	0.01	0.43
CDN Consumption	LDHP	0.07	0.19	0.05	0.16
CDN Government	LDHP	0.01	0.07	0.01	0.05
CDN Investment	LDHP	0.01	0.10	0.02	0.02
CDN Exports (goods)	LDHP	0.02	0.44	0.01	0.02
CDN Imports (goods)	LDHP	0.01	0.49	0.02	0.07
CDN Hours	LDHP	0.05	0.25	0.02	0.25
CDN Capacity utilization rate	DHP	0.02	0.48	0.01	0.02
CDN Unemployment rate	DHP	0.01	0.26	0.01	0.01
CDN Unit labor costs	LD	0.06	0.53	0.01	0.02
CDN M2	LD	0.02	0.05	0.02	0.03
CDN Bank rate	D	0.03	0.36	0.06	0.05
CDN CPI (all goods)	LD	0.10	0.05	0.02	0.05
CDN CPI (minus volatile components)	LD	0.02	0.04	0.02	0.02
CDN Producer price index excluding oil	LD	0.03	0.15	0.26	0.02
CDN Commodity price index - energy	LD	0.68	0.03	0.01	0.02
CDN Commodity price index - non energy	LD	0.05	0.08	0.07	0.04
CDN Export prices	LD	0.44	0.03	0.25	0.01
CDN Import prices	LD	0.06	0.09	0.66	0.03
CDN Shares price index (nominal)	LD	0.02	0.03	0.15	0.04

Source: Fund staff calculations.
1/ D = first difference, LD = log of first difference, DHP = deviation from HP trend, LDHP = log of deviation from HP trend.

substantially across variables, and to some extent also over time. The discussion below provides an overview.

10. ***The first factor can be interpreted as fluctuations in the world price of oil in U.S. dollars and in U.S. producer prices of intermediate inputs*** (Figure 2). It accounts for 65 percent and 82 percent of their respective variances and tracks these series closely. In the United States, this "oil" factor explains much of the variation in prices and the federal funds rate. In Canada, it accounts for a large amount of the variation in export and energy prices, some 10 percent of fluctuations in the headline CPI, but a smaller proportion of fluctuations in core CPI inflation, Canadian interest rates, and non-energy commodity prices.[11] Consistent

[11] The more limited impact on Canadian inflation compared to its U.S. counterpart presumably reflects the fact that oil prices are measured in the U.S. currency and hence change U.S. relative prices more directly.

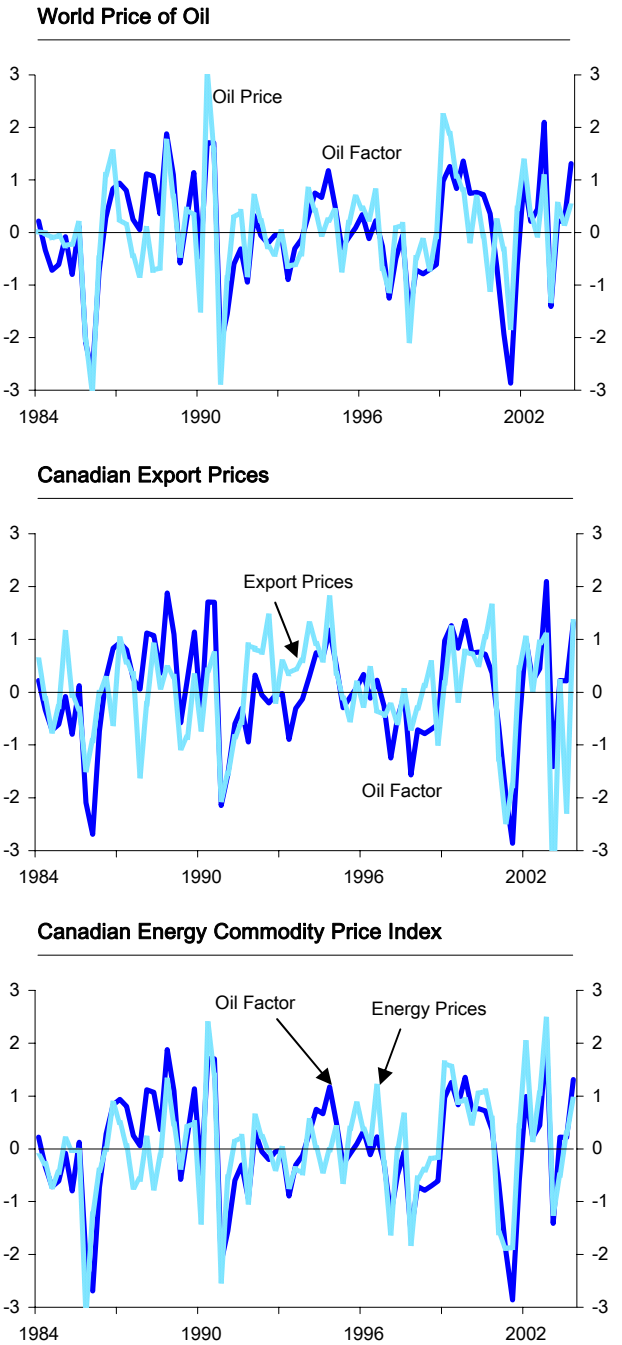
with post-1985 results reported in Kose *et al*. (2004), there is little interaction between oil prices and real variables.

11. ***The second external factor, which tracks the U.S. cycle, accounts for almost 60 percent of the deviations of U.S. real GDP from trend*** (Figure 3). It captures the recessions (and subsequent recoveries) of 1990 and 2001, as well as the slowdown in 1995 and can explain around half of the changes in the federal funds rate, particularly since 1987 (as can be seen from Figure 3, the federal funds rate tends to lead the cycle). The factor also explains about half of the movements in U.S. imports and one quarter of consumption movements.

12. ***This "U.S. cycle" factor has a large influence on Canadian real GDP and industrial production, explaining around half their variance***. The link with downturns in Canadian real GDP is particularly striking, whereas the synchronization of recoveries is less close—indeed, this factor often leads Canada's upturns. Interestingly, the factor suggests that the 2001 downturn in Canadian real GDP was less than would have been expected given the U.S. slowdown. More recently, however, the recovery of Canadian real GDP has lagged behind the "U.S. cycle" factor.

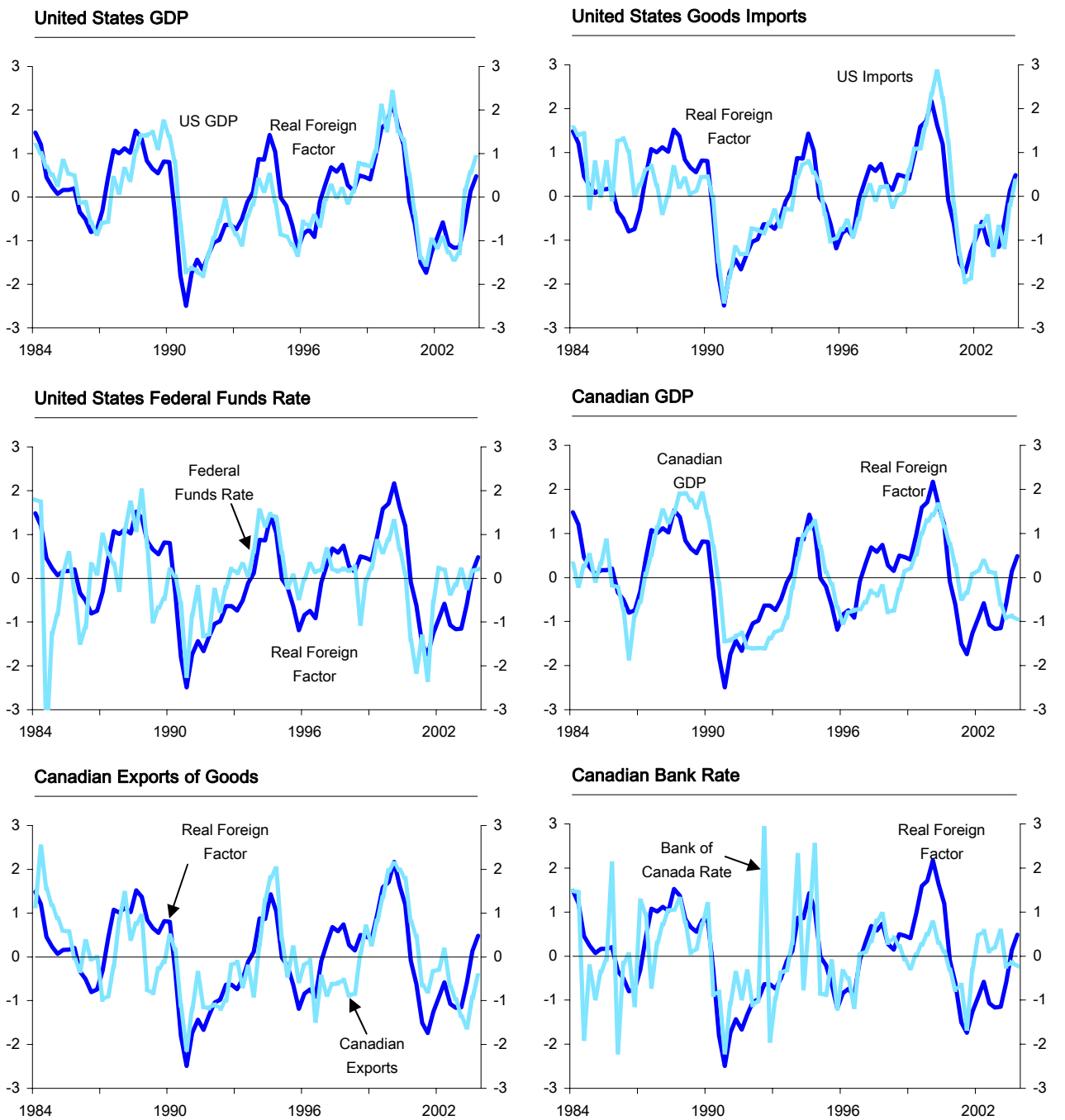
13. ***The results emphasize the role of trade linkages for the transmission of U.S. cyclical shocks***. The importance of trade linkages in explaining the synchronization of fluctuations between the United States and Canada is clear from the fact that the "U.S. cycle" factor explains about half of the variation in Canadian exports and imports. This relationship appears to have increased in the 1990s, plausibly reflecting greater economic integration over this period.

Figure 2. "Oil" Factor and Comovements in Selected Series 1/



Source: Fund staff calculations.
1/ Each series is divided by its standard deviation and its mean removed. Vertical axes are therefore measured in standard deviations.

Figure 3. "Real" Foreign Factor and Comovements in Selected Series 1/



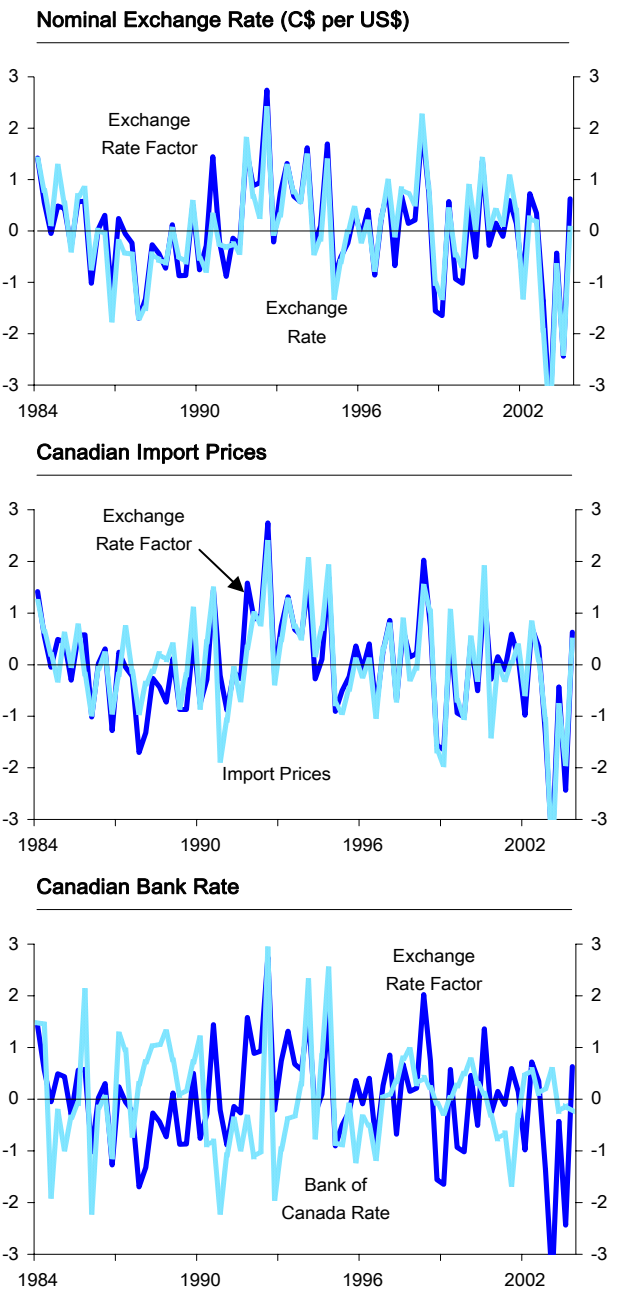
Source: Fund staff calculations.

1/ Each series is divided by its standard deviation and its mean removed. Vertical axes are therefore measured in standard deviations.

14. ***The "U.S cycle" factor also explains a significant proportion of fluctuations in Canada's bank rate, particularly since the mid-1990s, but reveals limited links between capacity and inflation***. It accounts for about one-third of the variation in Canada's bank rate, a relationship that seemed to strengthen in the 1990s. However, these two series behave quite differently in 1991—at the inception of the Bank of Canada's inflation targeting regime—and, to a lesser extent, more recently in 2002−2003. Despite the factor's important role for the Canadian real economy, its impact on inflation is quite limited, echoing the conclusions from other studies that have encountered difficulties in establishing a stable relationship between capacity measures and inflation.[12]

15. ***The third factor closely tracks movements in Canada's exchange rate and non-oil producer and commodity prices*** (Figure 4). As it might be expected, this factor is closely associated with movements in import prices and, to a lesser degree, export prices. However, the influence on fluctuations in headline and core CPI is limited, suggesting that pass-through from import prices subsides as goods move down the production chain. This "exchange-rate" factor also displays some comovements with Canada's bank rate in the 1980s and mid–1990s, excluding the 1990−91 period when inflation targeting was adopted. Nonetheless, this relationship seems to weaken considerably after 1998, around

Figure 4. "Exchange Rate" Domestic Factor and Comovements in Selected Series 1/



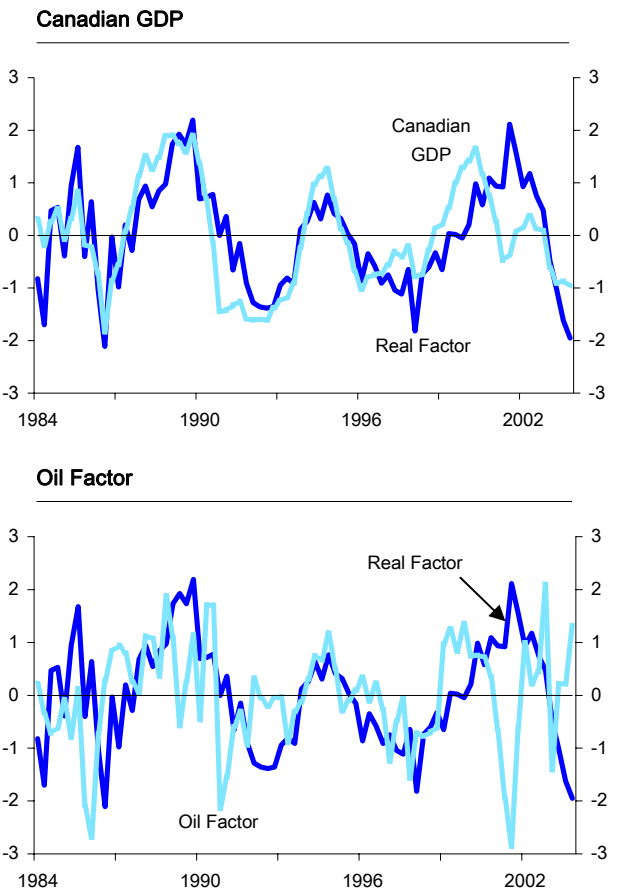
Source: Fund staff calculations.
1/ Each series is divided by its standard deviation and its mean removed. Vertical axes are therefore measured in standard deviations.

[12] Demers (2003) documents the instability of the Phillips Curve in Canada and finds that measures of cyclical activity are not linked to the evolution of inflation in most of our sample. Similar observations are discussed in Box 2 of the accompanying *Staff Report*.

the time that the Bank of Canada abandoned the Monetary Conditions Index (MCI) as an indicator of monetary policy.

16. ***The last factor corresponds to domestic disturbances responsible for Canada's cycle*** (Figure 5). The factor explains around half of fluctuations in Canadian real GDP and about one third of movements in industrial production.[13] A close link existed between this factor and fluctuations in Canada's real GDP through the mid-1990s. Subsequently, however, the two series became less correlated, similar to other variables that were well explained by this factor, such as industrial production, labor productivity, and hours worked.[14] This shift is also reflected in the precision with which this factor is estimated, evident from the widening error bands reported in Figure 1. Finally, the "U.S. cycle" factor appears to somewhat lead this "domestic cycle" factor. The correlation coefficients of the first and second lag of the U.S. factor with the Canadian factor are 0.17 and 0.34, respectively. This could indicate that the impact of U.S. fluctuations may be underestimated even under this flexible dynamic specification.

Figure 5. "Real" Domestic Factor and Comovements in Selected Series



Source: Fund staff calculations.
1/ Each series is divided by its standard deviation and its mean removed. Vertical axes are therefore measured in standard deviations.

C. Robustness Checks

17. ***The results appear generally robust to changes in the way the data were measured.*** This was examined by re-estimating the model with real variables measured as rates of change, rather than deviations from trend. Statistical methods indicated that the same model

[13] The four factors explain close to 95 percent of the variation in Canadian real GDP and industrial production, with the U.S. and Canadian cycles explaining almost 90 percent of the variance.

[14] As with the "US cycle" factor, this domestic real factor has very limited effects on CPI inflation. Indeed, it explains less than 5 percent of the variance of inflation.

structure—four factors with extremely similar features—remained valid. More generally, the results were extremely similar to the benchmark case with the following exceptions:

- ***The "oil" factor now explains a greater share of consumption***. This is particularly true for the United States.

- ***The spillovers from the U.S. cycle to Canadian real GDP and industrial production are lower***.[15] One possible explanation for this is that first differencing makes it more difficult to identify spillovers, as there is a greater degree of noise in the data.

18. ***Estimating the model with and without lags reveals the importance of spillover effects from external shocks***. The model was re-estimated excluding the lags in the impact of factors on individual series to explore the importance of this assumption on the results. Comparing the variance decompositions obtained with and without a lag indicates the following qualitative differences:

- ***The share of the variance explained by the U.S. real factor in the United States falls when the lag is excluded***. This is particularly true for "sluggish" variables such as the unemployment rate and investment.

- ***Without lags, the proportion of the variation in Canadian real GDP (as well as industrial production and unit labor costs) attributed to the U.S. cycle falls***.[16] This indicates that lags matter in the effects of U.S. activity on the Canadian economy.

D. Conclusions

19. ***The results from the estimation suggest that***:

- ***Four factors can explain a large amount of the fluctuations across a wide range of macroeconomic series in Canada and the United States***. For instance, they account for roughly 95 percent of the variance in Canadian real GDP and industrial production. The factors seem to correspond to world oil price shocks, the U.S. cycle, an exchange rate and non-oil price shock, and a Canadian cyclical factor.

- ***The fraction of the variance accounted for by factor varies substantially across series***. Fluctuations in Canadian real GDP are about equally explained by external and domestic cycles, while for other real series, inflation, and policy interest rates, the

[15] Variance shares for Canadian real GDP and industrial production explained by the external real factor are 15 and 22 percent respectively. Curiously, the lower variance shares for Canada's real GDP cannot be attributed to difficulties in explaining the volatility of Canadian trade volumes. Indeed, for real exports the proportion of the variance accounted for by the factor is higher in growth rates (56 compared to 46 percent).

[16] In contrast, variance shares remain largely unchanged for Canadian exports, labor productivity and capacity utilization rate.

role of external factors is even larger. Furthermore, our analysis provides evidence that the importance of the "Canadian" cyclical factor declined during the 1990s.

- ***These results appear relatively robust to alternative methods of detrending the data***. In addition, allowing for differences in the speed at which factors affect specific series is important for distinguishing spillover effects.

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Appendix Table 1. United States Data Sources, Descriptions, and Transformations

Series	Transformation 1/	Description 2/	Source
US Capacity utilization rate	DHP and D	Manufacturing Survey: Capacity Utilization Rate (SA, %)	OECD
US Consumption	LDHP and LD	Private Final Consumption Expenditure (SAAR, Millions Chained 2000 US$)	OECD
US CPI (all goods)	LD	All Urban Consumers, All Items	FRED, St. Louis
US Exports (goods)	LDHP and LD	Exports of goods (SAAR, Billions Chained 2000 US$)	OECD
US Federal funds rate	D	Effective Federal Funds Rates. Averages of Daily Values	FRED, St. Louis
US GDP	LDHP and LD	Gross Domestic Product (SAAR, Billions Chained 2000 US$)	OECD
US Government	LDHP and LD	Government Final Consumption Expenditure	OECD
US Hours	LDHP and LD	Total Private, Quarterly Averages (SA, Hours)	Bureau of Labor Statistics
US Imports (goods)	LDHP and LD	Imports of goods (SAAR, Billions Chained	OECD
US Industrial production index	LDHP and LD	Industrial Production Index (SA, 1997=100)	Federal Reserve Board
US Investment	LDHP and LD	Gross Fixed Capital Formation (SAAR,	OECD
US Labor productivity	LDHP and LD	Labor Productivity Index of the Total Economy	OECD
US M2	LD	Money Stock, M2.	Federal Reserve Board
US Producer price index finished goods	LD	PPI Finished Goods (SA, 1982=100)	Bureau of Labor Statistics
US Producer price index intermediate goods	LD	PPI Intermediate Materials, Supplies and Components (SA, 1982=100)	Bureau of Labor Statistics
US Shares price index (nominal)	LD	Standard & Poor's 500 Composite (1941-43=10)	Wall Street Journal
US Unemployment rate	DHP and D	Standardized Unemployment Rate (SA, %)	OECD
US Unit labor costs	LD	Unit Labor Cost, Business Sector (SA, 1992=100)	Bureau of Labor Statistics
World commodity price index	LD	Spot Commodity Price Index: All Commodities (1967=100)	Commodity Research Bureau
World price of oil (non-Opec countries)	LD	Average Crude Oil Spot Price: Total Non-OPEC ($/Barrel)	Department of Energy

1/ Abbreviations: D (Difference); LD (Log-Differences); DHP (Deviations from HP Trend); LDHP (Log-Deviations from HP Trend).

2/ Abbreviations: SA (Seasonally Adjusted); SAAR (Seasonally Adjusted Annualized Rates or Levels); NSA (Not Seasonally Adjusted); % (Percentage rate).

Appendix Table 2. Canada Data Sources, Descriptions, and Transformations

Series	Transformation 1/	Description 2/	Source
CDN Bank rate	D	Official Discount Rate of the Bank of Canada (Monthly Average, %)	Bank of Canada
CDN Capacity utilization rate	DHP and D	Manufacturing Survey: Capacity Utilization Rate (NSA, %)	OECD
CDN Commodity price index - energy	LD	Commodity Price Index, Energy (1982-90=100)	Bank of Canada
CDN Commodity price index - non energy	LD	Commodity Price Index, Total Excluding Energy (1982-90=100)	Bank of Canada
CDN Consumption	LDHP and LD	Private Final Consumption Expenditure (Millions Chained 1997 C$, SAAR)	OECD
CDN CPI (all goods)	LD	CPI, All Items (NSA, 1992=100)	Statistics Canada
CDN CPI (minus volatile components)	LD	CPI, All Items Excluding 8 Volatile Components & Indirect Taxes (NSA, 1992=100)	Bank of Canada
CDN Export prices	LD	Export Price Index (SA, 1992=100)	Statistics Canada
CDN Exports (goods)	LDHP and LD	Exports of goods (SAAR, Millions Chained 1997 C$, SAAR)	OECD
CDN GDP	LDHP and LD	Gross Domestic Product (Millions Chained 1997 C$, SAAR)	OECD
CDN Government	LDHP and LD	Government Final Consumption Expenditure (Millions Chained 1997 C$, SAAR)	OECD
CDN Hours	LDHP and LD	Actual Hours Worked During Reference Week, All Sectors (SA, Thousands of Hours)	Statistics Canada
CDN Import prices	LD	Import Price Index (SA, 1992=100)	Statistics Canada
CDN Imports (goods)	LDHP and LD	Imports of goods (SAAR, Millions Chained 1997 C$, SAAR)	OECD
CDN Industrial production index	LDHP and LD	Industrial Production Index (SA, 2000=100)	OECD
CDN Investment	LDHP and LD	Gross Fixed Capital Formation (Millions Chained 1997 C$, SAAR)	OECD
CDN Labor productivity	LDHP and LD	Labor productivity index of the total economy	OECD
CDN M2	LD	M1 plus All Checkable Notices and Personable Term Deposits	Bank of Canada
CDN Nominal exchange rate	LD	U.S. Dollar Noon Spot Rate (C$/US$)	Bank of Canada
CDN Producer price index excluding oil	LD	Producer Price Index, Total excluding Petrol/Coal Products (NSA, 1997=100)	Statistics Canada
CDN Real exchange rate	LD	Broad Real Effective Exchange Rate Index (2000=100)	JP Morgan
CDN Shares price index (nominal)	LD	S&P/TSX: 60 Index (1/29/1982=100)	Bank of Canada
CDN Unemployment rate	DHP and D	Standardized Unemployment Rate (SA, %)	OECD
CDN Unit labor costs	LD	Unit Labor Cost, Manufacturing (SA, 2000=100)	OECD

1/ Abbreviations: D (Difference); LD (Log-Differences); DHP (Deviations from HP Trend); LDHP (Log-Deviations from HP Trend).
2/ Abbreviations: SA (Seasonally Adjusted); SAAR (Seasonally Adjusted Annualized Rates or Levels); NSA (Not Seasonally Adjusted); % (Percentage rate).

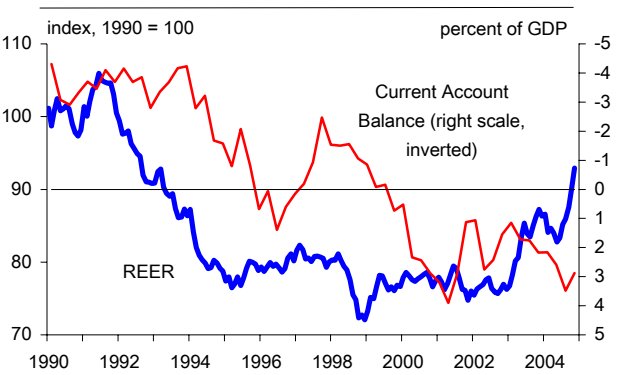
II. The Effects of U.S. Shocks on the Canadian Economy: Results from a Two-Country Model[17]

A. Introduction and Summary

1. ***The close integration of the Canadian and U.S. economies means that U.S. shocks are quickly transmitted across the border***. Canada's exports to the United States account for about 85 percent of total Canadian exports and about 35 percent of its GDP, and investment flows and financial market ties are also closely linked. As documented by Kose (2004), the increased trade and financial linkages that resulted from the 1989 Canada-U.S. free trade agreement have significantly increased the impact of the U.S. business cycle on Canada, but Canada's vulnerability to U.S. shocks also stems from its relatively small size and the importance of its natural resource sector.[18]

2. ***The recent strength of the Canadian dollar has intensified interest in the impact of U.S. shocks on the Canadian economy and monetary policy***. The vigor of Canada's net exports during the past year has been surprising, given the 30 percent appreciation of the Canada/U.S. dollar exchange rate since early 2003 (Figure 1). Competing explanations for the modest impact on trade have been offered, including that it has reflected an increase in the flexibility and efficiency of Canadian industry, a decline in exchange rate pass-through, or delays in the usual adjustment process.

Figure 1. Real Effective Exchange Rate and Current Account Balance



Sources: Haver Analytics; and IMF's Information Notice System.

3. ***These issues are explored here using a small two-country macroeconomic model.*** In particular, the model is used to investigate how changes in the exchange rate pass-through impact on the transmission of an exchange rate shock on the real economy. The results offer two key insights:

- ***The Canadian economy responds significantly to U.S. macroeconomic and policy shocks, as well as to exchange rate shocks.*** However, there is considerable scope for monetary policy to respond to ameliorate the effects of these shocks.

[17] Prepared by Iryna Ivaschenko and Andrew Swiston. The authors are grateful to Douglas Laxton for invaluable help with the model.

[18] In 2003, Canada's GDP was equivalent to about 8 percent of U.S. GDP, and domestic absorption accounted for 7 percent of that in the United States.

- ***The strength of net exports in 2004 appears to be at least partially related to a decline in the pass-through coefficient.*** The weakening of pass-through —if it is sustained—would significantly reduce the impact of exchange rate shocks on both GDP and inflation.

B. Model Description

4. ***The model employed for this study is a two-country version of a small open economy model.***[19] Each economy is characterized by three equations—an IS curve, an expectation-augmented Phillips curve, and a monetary policy reaction function. Canada is assumed to face both domestic and external shocks (i.e., from the United States), while the United States is assumed to be large enough to be essentially treated as a closed economy. The model allows U.S. output shocks to feed into the Canadian IS equation, while real exchange rate shocks affect both the IS equation and the Phillips curve. For the sake of simplicity, the effects of fiscal policy are not modeled. For Canada, the equations are:

- ***IS curve***

$$ygap_t = \beta_{lead}\, ygap_{t+1} + \beta_{lag}\, ygap_{t-1} - \beta_{RR}(RR_{t-1} - RR^*_{t-1}) + \beta_{zgap}\, zgap_{t-1} + \beta_{US}\, ygap^{US}_t + u^{ygap}_t \quad (1)$$

where *ygap* is the Canadian output gap; *RR* the Canadian real short-term interest rate; RR^* the equilibrium real interest rate for Canada; and $ygap^{US}$ the U.S. output gap; z_t is the Canadian/U.S. dollar exchange rate, in real terms; z^*_t is the equilibrium real exchange rate; and $zgap_t = z_t - z^*_t$ is the exchange rate gap.

- ***Phillips curve***

$$\pi_t = \alpha_{lead}\, \pi^4_{t+4} + (1 - \alpha_{lead})\, \pi^4_{t-1} + \alpha_{ygap}\, ygap_{t-1} + \alpha_z\, (z_t - z_{t-1}) + u^{\pi}_t \quad (2)$$

where π is the annualized quarterly inflation rate; and π^4 is the four-quarter inflation rate.[20]

- ***Monetary policy reaction function***

$$RS_t = \gamma^{RS}_{lag}\, RS_{t-1} + (1 - \gamma^{RS}_{lag})[RR^*_t + \pi^4_t + \gamma_{\pi}(\pi^4_{t+4} - \pi^*_{t+4}) + \gamma_{gap}\, ygap_t] + u^{RS}_t \quad (3)$$

where *RS* is the target for the nominal overnight rate, i.e., the Canadian monetary policy rate. The terms u^{ygap}, u^{π}, and u^{RS}_t are error terms. This is equivalent to assuming that the Bank allows the real short-term interest rate to deviate from its "equilibrium" level depending on whether the inflation rate that is expected to prevail four quarters ahead deviates from the

[19] Lane (2003) provides a review of the new open-economy literature. See Berg, et al. (2005) for a description of the model used here.

[20] The results of estimating the model with either core or headline inflation are qualitatively the same.

target, π^*, or whether output deviates from potential. Interest rate smoothing is permitted, however—i.e., the short-term interest rate is set with reference to its value last period.

- ***Real exchange rate (uncovered interest rate parity)***

$$z_t = z^e_{t+1} - (RR_t - RR^{US}_t - \rho^*_t)/400 + \varepsilon^z_t \quad (4)$$

where ρ^*_t is an interest rate premium. Exchange rate expectations are assumed to follow an autoregressive process: $z^e_{t+1} = \delta_z z_{t+1} + (1-\delta_z)z_{t-1}$.

5. ***Similar equations are assumed for the U.S. economy.*** However, since the U.S. economy is assumed not to be affected by Canadian shocks, the U.S. IS curve includes neither the foreign output gap nor the Canada/U.S. exchange rate. Moreover, the U.S. Phillips curve does not include the exchange rate.

C. Data and Estimation

6. ***The model is computationally tractable and provides for a close integration with the IMF's medium-term forecasting framework.*** Owing to its simplicity, the model can be easily applied to medium-term economic forecasts provided for the Fund's *World Economic Outlook*, for example, to consider the effects of different policy responses or the validity of model assumptions.[21] It also facilitates the application of sophisticated estimation and simulation techniques that have been developed in recent years.

7. ***The model employs Bayesian estimation techniques.*** This approach incorporates prior knowledge about parameter values, which is especially useful given the short data sample. It also provides information on distribution of model parameters and shocks. All shocks are modeled as first-order autoregressive processes with normally distributed error terms, with the sole exception of the exchange rate shock, which is assumed to be normally distributed. In addition, all data are assumed to include some parameterized measurement error to account for data uncertainty related to the possibility of future revisions.

8. ***The model uses quarterly data from 1996 through the third quarter of 2004.*** The sample period was chosen to exclude transition effects from Canada's adoption of an inflation target in 1991. The model was first estimated using historical data, and then simulated over the forecast horizon. The equilibrium values of variables (i.e., the starred variables) were determined using a version of the Hodrick-Prescott filter (except for the Canadian inflation target, which is set at 2 percent).

[21] See Coats and others (2003) and references therein.

D. Results

9. ***The simulation results indicate that real shocks to the U.S. economy significantly affect both Canadian GDP and inflation.*** The effect of a 1 percentage point increase in U.S. GDP, which stems from a temporary demand shock linked to the IS curve, is to raise Canadian GDP by almost ½ percent and inflation by ⅓ percentage point (Figures 2 and 3). Conversely, a permanent 1 percent reduction in U.S. potential output—which would be equivalent to a negative U.S. supply shock—reduces the level of GDP in Canada by about 1½ percent and inflation by 1 percentage point over six quarters.

10. ***The model can be used to illustrates the costs of delaying the monetary policy response to external and other shocks***. For example, if Canadian monetary policy were assumed to respond with a four-quarter lag (rather than immediately as is implied by the monetary reaction function described above), the impact of the temporary U.S. demand shock would be about ¼ percent larger over 4 quarters, and CPI inflation would be correspondingly higher (Figures 2 and 3). Moreover, the delayed monetary policy response requires a larger interest rate movement—in this case the Bank is required to raise its policy rate by about ½ percentage point more in the quarter of the move than otherwise.

11. ***The speed of the monetary policy response is also important in determining how U.S. inflation shocks affect the Canadian economy.*** For example, the impact of a 1 percentage point U.S. inflation shocks—which is modeled as shock to the U.S. Phillips curve—on Canada's GDP and inflation would be roughly halved by an immediate response from the Bank of Canada versus a delayed response.

12. ***The model illustrates that U.S. monetary policy has a relatively modest effect on Canada.*** For example, even if the monetary policy reaction were delayed by four quarters, a 100 basis point increase in the federal funds rate would reduce Canadian GDP by only about 0.1 percent over six quarters (Figure 4). Again, allowing an immediate policy response would halve this (already small) effect, with the impact on Canadian inflation being negligible in both cases.

13. ***The impact on Canada of exchange rate shocks is relatively strong, however, reflecting its export dependency*** (Figure 5)**.** Simulation results suggest that a 20 percent real appreciation of the Canadian dollar vis-à-vis the U.S. dollar reduces Canada's GDP by about 1 percent over four quarters, even if the Bank of Canada were to immediately reduce its target rate by 1½ percent. This effect almost doubles if rate hikes are delayed.

14. ***However, the model also illustrates that the effect of exchange rate shocks depends significantly on the degree of pass-through*** (Figure 6)**.** If the pass-through coefficient, β_{zgap}, in equation (1) is lowered by half, the impact of an exchange rate appreciation on GDP is reduced by about a quarter, and on the rate of inflation by nearly a half. This result is consistent with the view of a number of analysts in Canada that the seemingly modest response of Canadian net exports and growth in 2004 to the strong appreciation of the

Canadian dollar over the past 2–3 years is partially accounted for by a decline in exchange rate pass-through.

E. Conclusions

15. ***Using a simple two-country version of the small open economy model, this paper evaluates impact of the shocks to the U.S. economy on Canada.*** The results suggest that monetary policy can play an important role in reducing the effect of U.S. and exchange rate shocks on the Canadian economy. They also indicate that the exchange rate pass-through plays a significant role in determining the impact of the exchange rates shocks on Canada.

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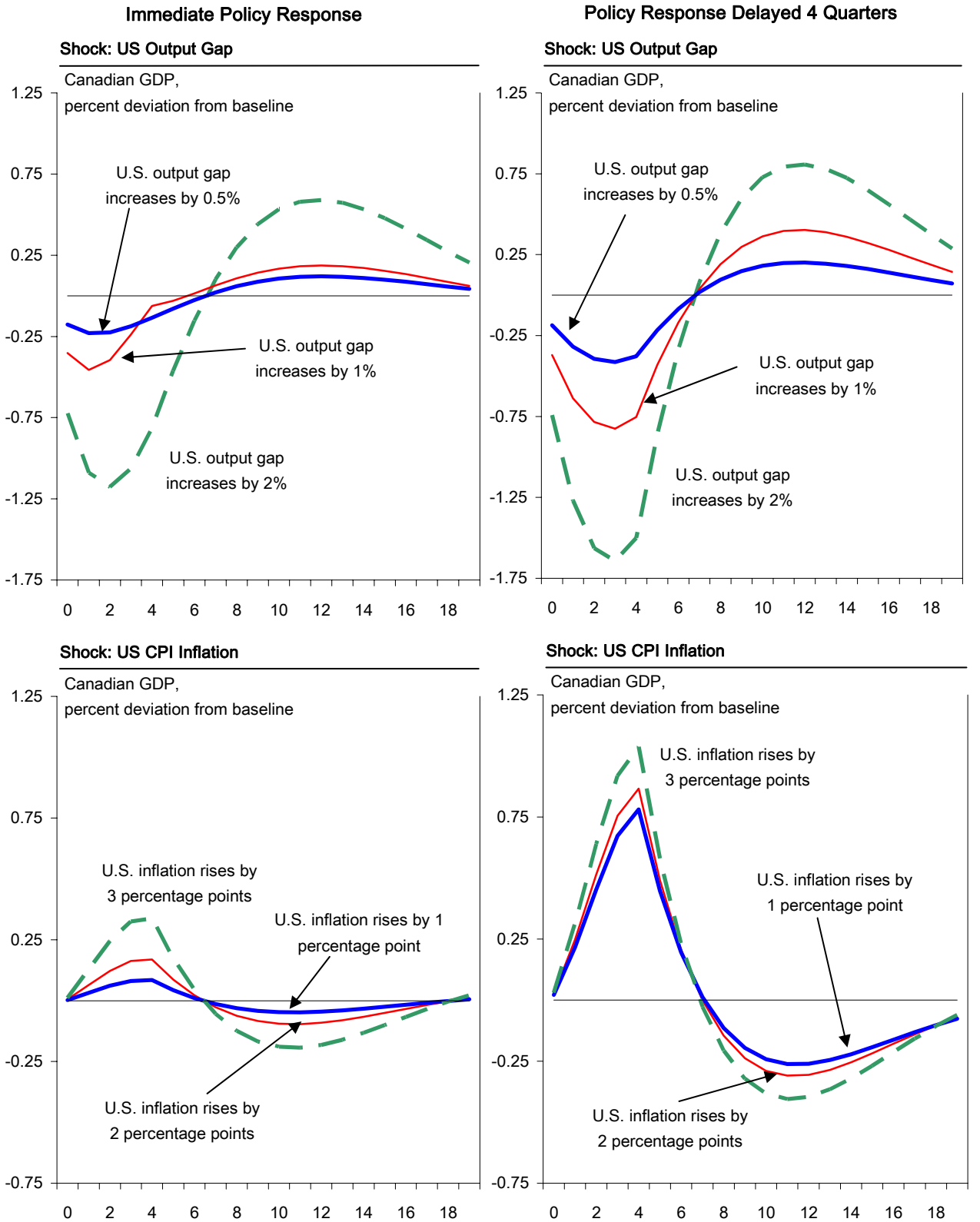
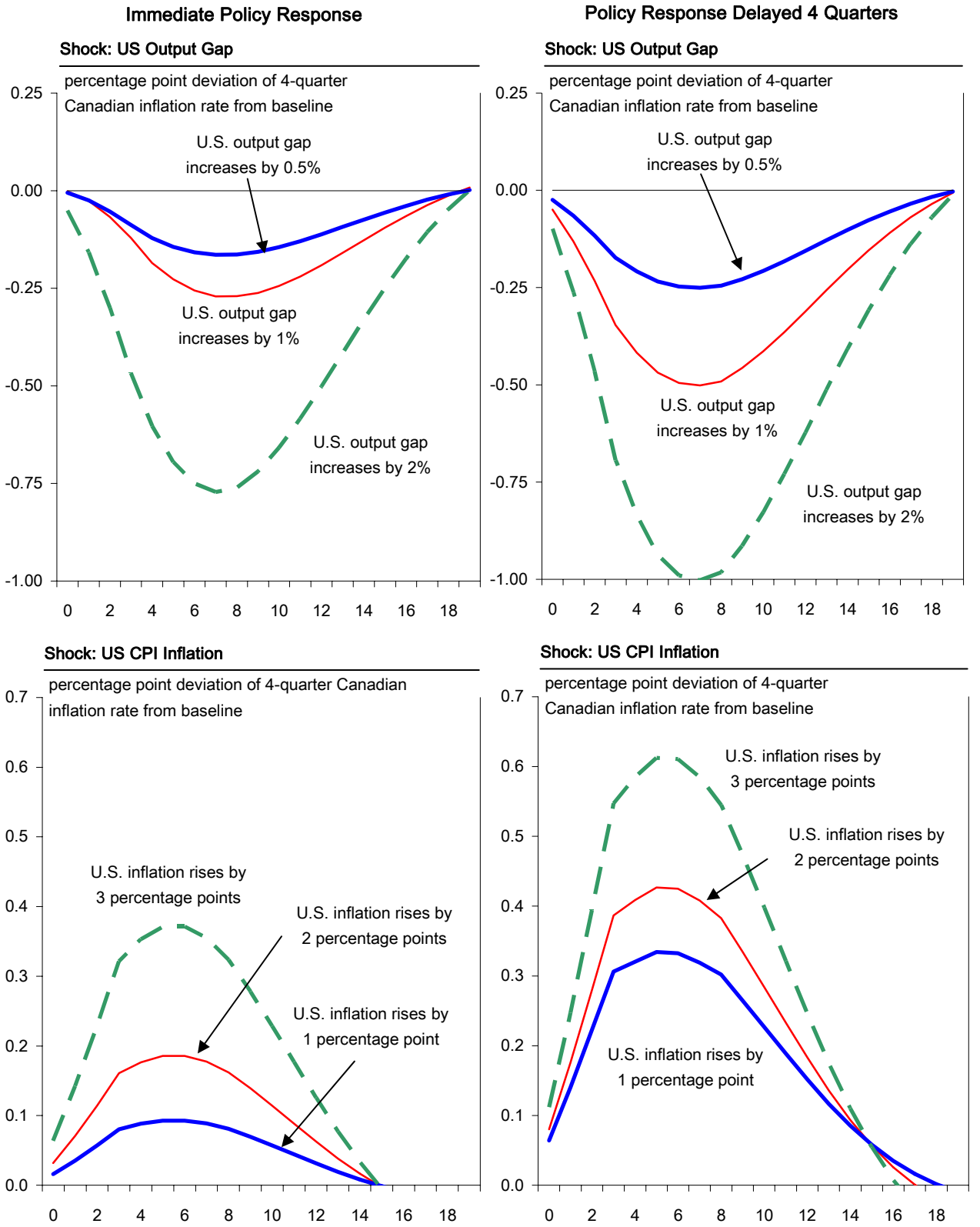
Figure 2. Response of Canadian GDP to U.S. Shocks,
with Immediate and Delayed Monetary Policy Response



Source: Fund staff calculations.

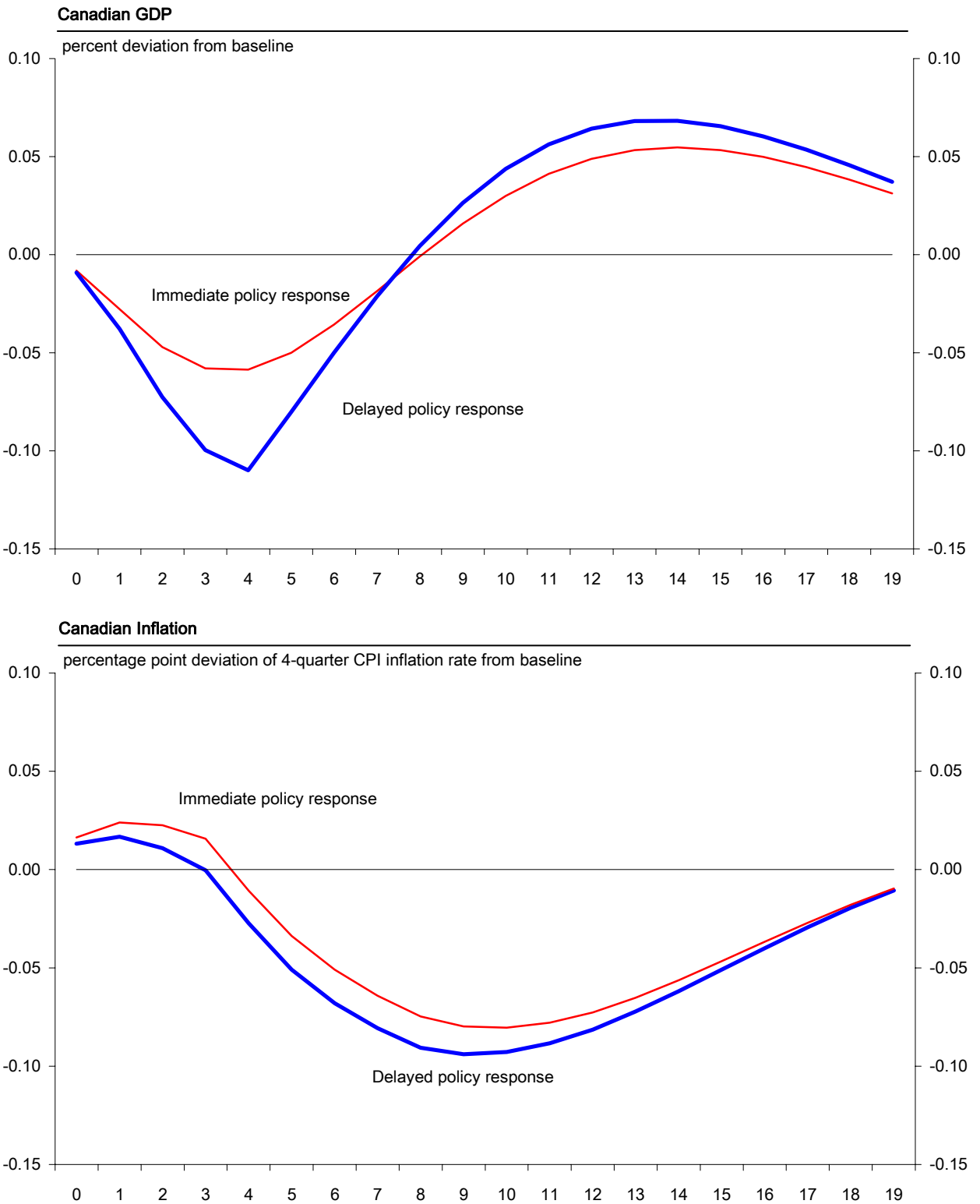
Figure 3. Response of Canadian CPI to U.S. Shocks,
with Immediate and Delayed Monetary Policy Response



Source: Fund staff calculations.

Figure 4. Responses of GDP and Inflation to U.S. Policy Shocks, with Immediate and Delayed Monetary Policy Response

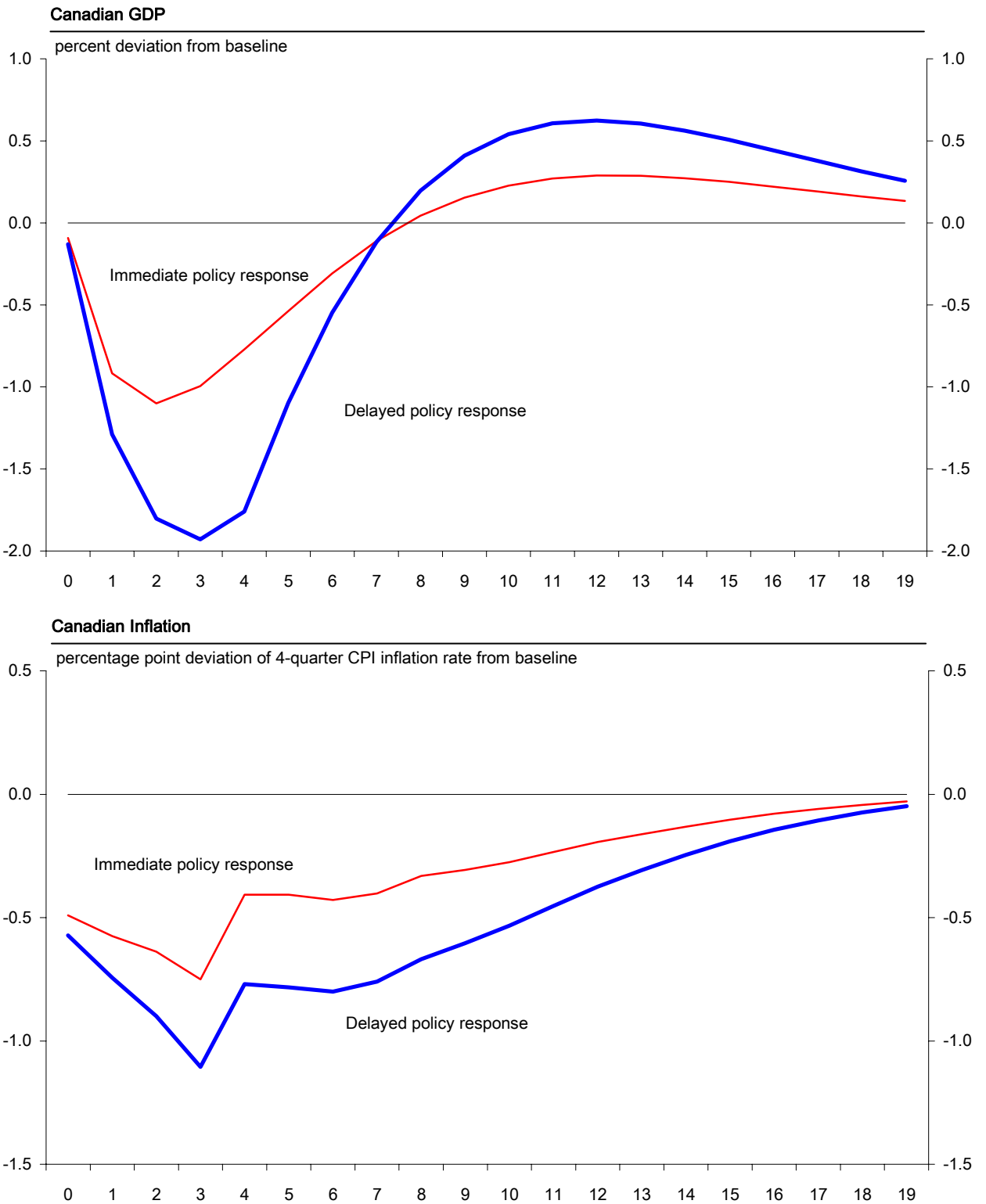
Shock: US interest rates, 100 basis point increase



Source: Fund staff calculations.

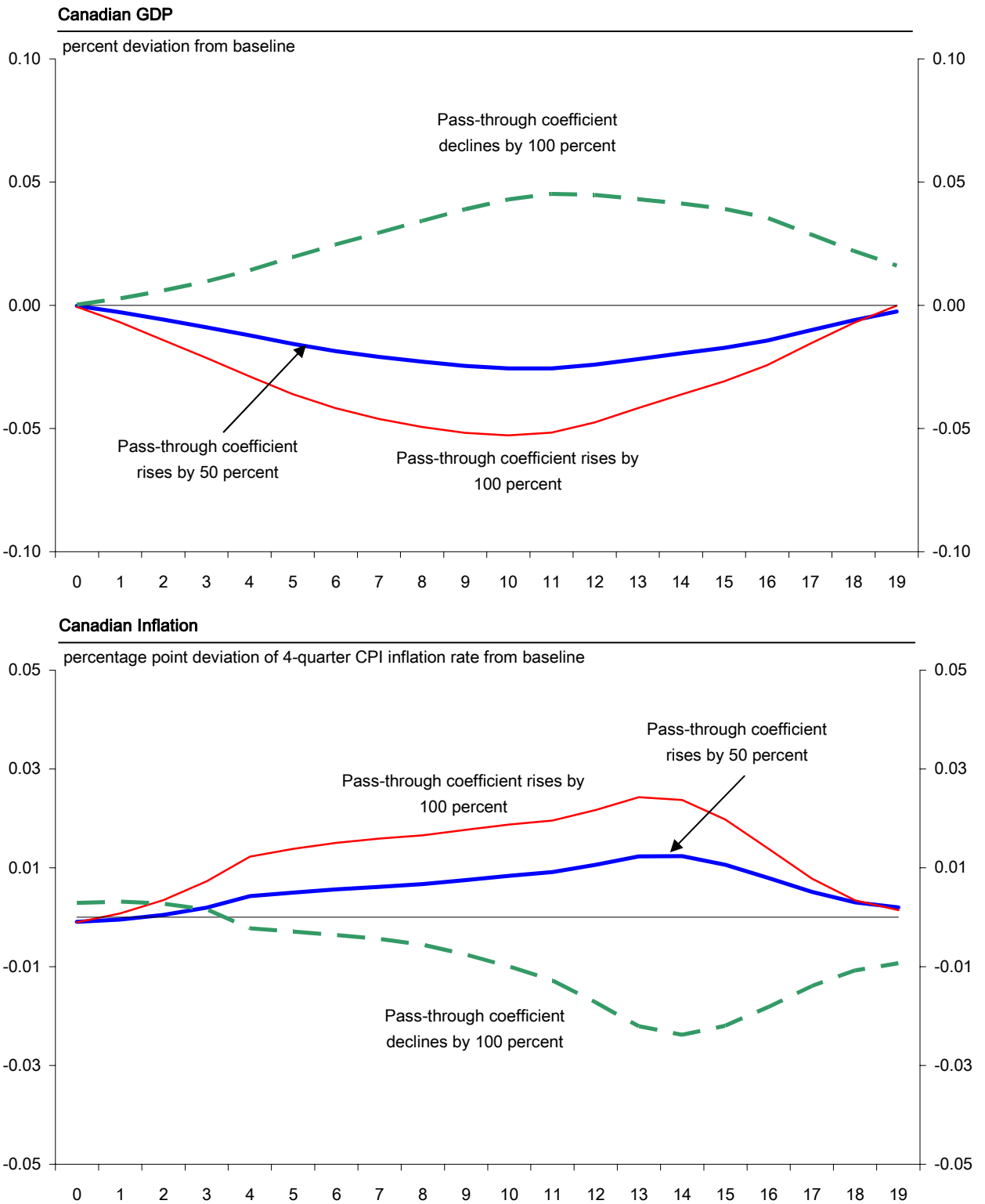
Figure 5. Responses of GDP and Inflation to Exchange Rate Shock, with Immediate and Delayed Monetary Policy Response

Shock: Twenty percent appreciation of exchange rate



Source: Fund staff calculations.

Figure 6. Responses of GDP and Inflation to Changes in the Pass-through Coefficient, with Immediate and Delayed Monetary Policy Response



Source: Fund staff calculations.

PART II: FISCAL ISSUES

III. JAM TODAY OR MORE JAM TOMORROW? ON CUTTING TAXES NOW VERSUS LATER[22]

A. Introduction

1. ***The Canadian fiscal framework adopted in the mid-1990s has led to a rapid reduction in government debt in recent years***. The federal objective of budget balance or better has resulted in seven consecutive years of fiscal surpluses and by far the largest reduction in debt across G-7 countries (see the discussion in Box 1 of the accompanying *Staff Report*). Fiscal prudence, together with reforms of the public pension system that have put it on an actuarially sound basis, have left Canada relatively well prepared to cope with the fiscal pressures from population aging.

2. ***This paper uses the Fund's Global Fiscal Model (GFM) to examine the long-term benefits from reducing government debt by delaying tax cuts as well as issues of tax spillovers***. GFM has been recently developed at the Fund to examine fiscal policy issues. The simulations in this paper examine the consequences of foregoing immediate tax cuts in response to reductions in government spending so that government debt falls, allowing larger tax cuts in the future. In addition, the impact of tax rate changes in the rest of the world on Canada is also examined.

B. The Model and Calibration

3. ***The Fund's GFM model is a micro-founded model that has been developed specifically to examine fiscal issues***. It is part of a suite of models with similar underlying structures adapted to look at different macroeconomic issues.[23] These models share important characteristics, including a firm grounding in microeconomic theory—consumers maximize utility and firms do the same with profits—ensuring that the long-run properties of the model conform to those predicted by theory. As the underlying parameters correspond to assumptions about underlying behavior (such as the elasticity of substitution of hours worked with respect to real wages or consumption with respect to the real interest rate) these models are well designed to analyze how simulations depend on key behavioral assumptions, while real and nominal rigidities generate realistic dynamic responses. Finally, these models allow for more than one country, and hence can examine international linkages, a major theme of Fund work.

4. ***Several features of GFM make it particularly well suited to examine fiscal issues***:

- ***The private sector is impatient.*** More specifically, the discount rate used by the private sector is higher than the real rate of interest. In the absence of such

[22] Prepared by Tamim Bayoumi and Dennis Botman (FAD).

[23] See Bayoumi (2004) for a discussion of the overall modeling effort and Botman, *et al*. (2005) for a description of GFM.

impatience, the private sector fully anticipates the future costs of tax changes, leading to the Ricardian result that movements in aggregate demand from changes in taxes or transfers have no impact on spending. Additionally, the model assumes that a certain proportion of wages accrue to "rule-of-thumb" individuals who vary their consumption one-for-one with their post-tax income. Finally, tax rates also distort relative prices, and hence the allocation of resources.[24]

- ***Markets are not fully competitive.*** Firms and workers have some monopolistic power, implying that prices are above their perfectly competitive levels. The most important consequence of this is that a corporate income tax affects not only the return to capital, but also the economic rent firms are able to extract from their monopolistic power. As a result, corporate income taxes are less distortionary than in the case where these rents do not exist.

- ***The remainder of the model can be briefly summarized as follows.*** Consumption and production are characterized by constant elasticity of substitution utility/production functions. There are two factors of production, labor and capital, which can be moved across sectors to produce traded or nontraded goods. Investment is driven by a Tobin's Q-relationship, in which firms respond sluggishly to differences between the future discounted value of their profits and the market value of their capital stock. Perfect capital mobility implies that real interest rates in countries are equalized over time.[25] Wages and prices are assumed perfectly flexible, which reduces the short-term aggregate demand impact of fiscal policies. Accordingly, the discussion will focus on medium- and long-term results. This paper uses a two-country version of the model.

5. ***The impact of a tax cut on real activity depends on the response of aggregate supply and demand***. The supply-side effects come through the increase in equilibrium hours worked (as a drop in the wage tax rate raises take home wages) or the capital stock (as a cut in the corporate income tax rate increases post-tax rates of return). The increase in aggregate demand depends on the extent to which individuals view a larger fiscal deficit as an increase in their permanent income, which, in turn, depends on nominal rigidities, the level of impatience, and the proportion of rule-of-thumb consumers. Over the longer-term, these effects spill over to other countries as the global real interest rate rises to re-equilibrate aggregate demand and supply.

6. ***The model was parameterized to reflect the macroeconomic features of Canada and the rest of the world***. The latter is based on the United States, Canada's main trading partner. Canada is about one-tenth of the size of the rest of the world, and hence its policies have only

[24] The model is not useful, however, for analyzing issues of intergenerational equality.

[25] Lower levels of international capital mobility would raise the beneficial effects of debt reduction for the Canadian economy, while lowering spillover from tax policy in the rest of the world.

a limited impact on the global rate of interest. The ratios relative to GDP of consumption, investment, government spending, wage income, and income from capital correspond to those in Canada and the United States. Canadian exports and imports as a ratio to GDP are set at current values. Tax rates on capital, labor, and consumption have been calibrated to reflect current yields across the two economies.[26]

7. ***A number of other key behavioral parameters are set equal across the two economies***.[27] In addition to those characterizing real rigidities in investment and the markups of firms, simulations examine the impact of changing the values of the following key parameters:

- ***The Frisch elasticity of labor supply, which measures the sensitivity of labor supply to real wages***. In the baseline, this is set at 0.04, in the mid-range of values produced by microeconomic studies. Alternative simulations assume values of 0.08 and 0.01, around the upper and lower limits of these estimates.

- ***The elasticity of substitution between labor and capital in the production function***. In the baseline, this is set at -0.8, while alternative simulations use values of -0.6 and -1 (the latter is the familiar Cobb-Douglas case, which implies constant shares of income accruing to labor and capital).

- ***The intertemporal elasticity of substitution of consumption, which measures the sensitivity of consumption to changes in the real interest rate***. This is set at -0.33 in the base case, with a lower and upper level of -0.25 and -0.5, again broadly covering the range of microeconomic estimates.

- ***The impatience of forward-looking consumers***. This parameter has not been subject to significant microeconomic analysis. One approach is to consider the gap between interest rates charged to consumers on credit card debt, the main source of unsecured loans in which the lender takes the full risk that consumers may be unable to repay, and government debt. Given the substantial margins seen in this comparison, the private sector discount rate was set some 10 percentage points above the real rate of interest, while simulations are also reported with wedges of 5 percentage points and 15 percentage points.

- ***The proportion of wages associated with "rule-of-thumb" consumers***. In the base case, this parameter was set at 10 percent, being raised to 20 percent and set to zero in alternative simulations. At the macroeconomic level, consumption is known to be

[26] Rather than try to model the complexities of actual tax systems, it is assumed that taxes are levied on the relevant base as a single marginal rate, so there is no difference between average and marginal tax rates. Were taxes assumed to be progressive, this would lead to small reductions in tax rates and hence distortions.

[27] See Laxton and Pesenti (2003) for a more detailed discussion of evidence on parameter values.

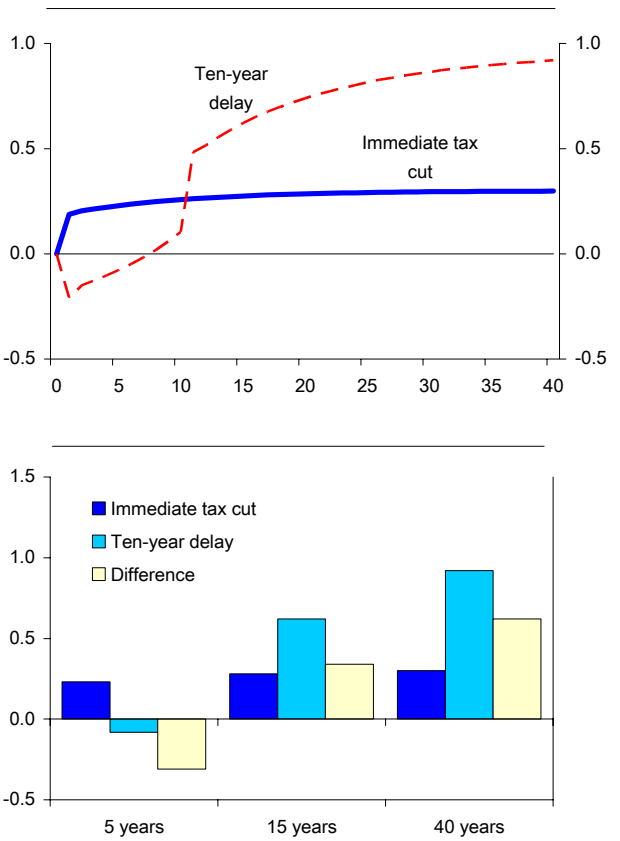
relatively sensitive to changes in disposable income, although some of this comes from the impatience of forward-looking consumers discussed above. In the base parameterization, the assumptions about impatience and rule-of-thumb consumers imply a multiplier of around one-fourth for temporary tax cuts or changes in income, broadly in line with other empirical work.[28]

C. Results of Cutting Transfers and Lowering Taxes Immediately or Later

8. ***This section compares the consequences of matching a cut in transfers with an immediate tax cut versus a larger tax cut that occurs later.*** The simulations assume that room for tax cuts is provided by a permanent cut in lump-sum transfer payments of one percentage point of GDP. [29] The results compare the following two policy responses: (i) immediately implementing a permanent cut in tax rates so as to reduce tax revenues by the same amount as the cut in transfer payments; and (ii) leaving tax rates unchanged for 10 years, followed by a larger permanent cut in tax rates made possible by the lower level of interest costs due to the intervening fall in the government debt ratio. In the second scenario, the government ends up with permanently lower tax rate and levels of government debt, but at the cost of not offsetting the negative short-term impact of the cut in transfers on aggregate demand. While such scenarios are clearly stylized—in practice, the main reason for reducing government debt at present is to prepare for the future pressures on government spending from population aging—they help illustrate the effects of choosing to cut taxes or reduce debt in a simple and intuitive manner.[30]

Figure 1. Effects on Real GDP of Reducing Transfers and Cutting Wage Tax Immediately and with a Delay

(percent deviation from baseline)



Source: Fund staff calculations.

[28] For a discussion of current evidence on fiscal multipliers, see IMF (2004).

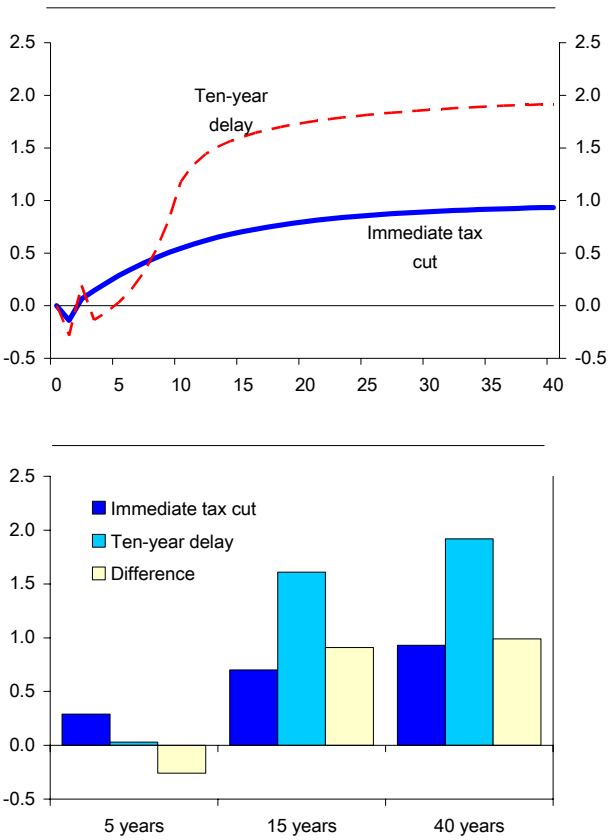
[29] Lump-sum transfers have no impact on incentives, and hence allow a focus on the distortions caused by tax rates.

[30] The baseline also does not take account of future fiscal pressures from population aging. However, as the model is approximately linear, the results would not be significantly altered if the baseline was changed.

9. ***Results for the base parameterization suggest that there are significant long-term benefits to delaying a cut in wage taxes, but there are also costs to not offsetting the fall in transfers in the short term*** (Figure 1). Immediately replacing a one percentage point of GDP reduction in lump sum transfers with a cut in wage taxes leads to a 0.3 percent increase in real GDP. About two-thirds of this boost occurs relatively rapidly, as the reduction in taxes leads to a boost in hours worked, while the remainder accumulates more slowly as the capital stock rises. Delaying the cut in wage taxes by 10 years results in a small fall in real GDP after 5 years as the impact on aggregate demand of the reduction in transfer payments is not offset, but also leads to an eventual tax rate reduction that is one-and-a-half times larger than when taxes are cut immediately. Once implemented, the larger tax cut leads to real GDP gains that rise gradually from double to triple those with an immediate tax cut.

Figure 2. Effects on Real GDP of Reducing Transfers and Cutting Corporate Income Taxes Immediately and with a Delay

(percent deviation from baseline)



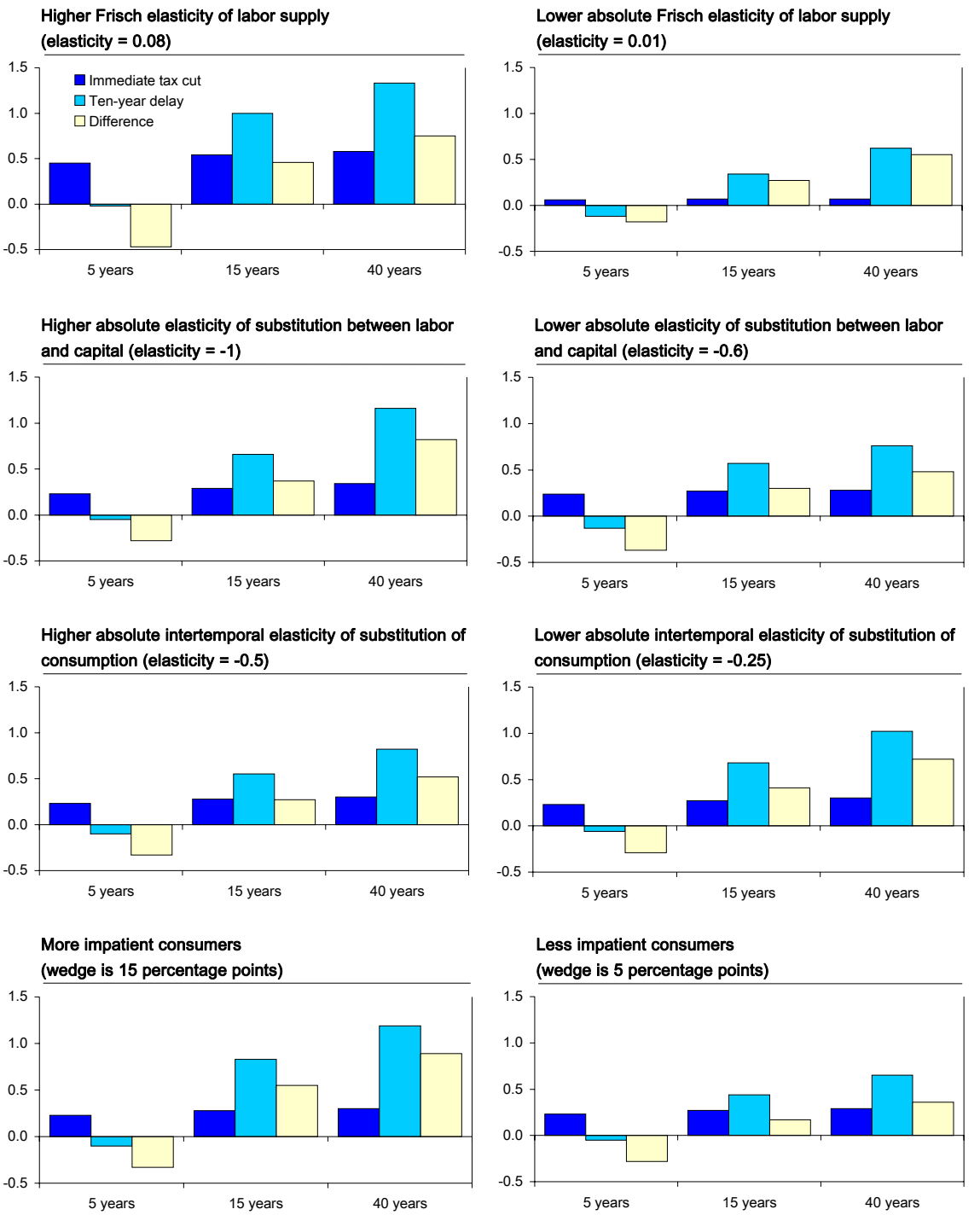
Source: Fund staff calculations.

10. ***Cuts in corporate income taxes produce larger benefits that accumulate more slowly over time, while delaying cuts produce a similar ratio of losses and benefits*** (Figure 2). Replacing an immediate cut in wage taxes with a cut in corporate income taxes leads to a similar gain in real GDP after 5 years and a much larger gain over time as capital is accumulated. The larger long-term benefits from a cut in corporate income taxes compared to wage taxes reflects the fact that the corporate tax is more distortionary as the supply of capital (which can be easily reproduced) is more elastic than that of labor—a standard result in the literature.[31] Delaying the cut in taxes for 10 years again implies forgoing significant benefits to real GDP over the first 5 years in return for reaping benefits that are of the order of double the base case beyond ten years.

11. ***A key advantage of a model such as GFM with well-defined microeconomic foundations is that the implications of alternative behavioral assumptions can be examined***. Figure 3 reports the change in real GDP after 5 years, 15 years, and 40 years when wage taxes are cut immediately, after 10 years, and the difference between these two values for a range of parameter values. The results after 5 years can be interpreted as the medium-term effect of the cut in spending and

[31] For a Canadian application, see Finance Canada (2004).

Figure 3. Effects of Alternative Parameterizations on Impact of a Cut in Transfers and in the Wage Tax Rate on Real GDP
(percent deviation from baseline)



Source: Fund staff calculations.

(if implemented) the tax cut, those after 15 years represent the medium-term impact of a delayed tax cut, while the results after 40 years represent the long-term impact of alternative scenarios.

12. ***The results indicate that the Frisch elasticity of labor supply largely determines the overall size of the wage tax distortion***. The benefits from immediate cuts in wage taxes vary approximately proportionally with the value of the Frisch elasticity of labor supply, for example, approximately doubling when it is raised from 0.04 to 0.08. This is because the elasticity determines the response of hours worked to changes in post-tax real incomes and hence the distortion to labor supply. No other parameter has a significant effect on the impact of an immediate cut in wage taxes.

13. ***The Frisch elasticity also has a proportional impact on the dynamic benefits of delaying wage tax cuts, while the ratio of short-term losses to long-term benefits rises as consumption becomes less sensitive to the real interest rate***. The difference in the changes in real GDP implied by the different timing of tax cuts again vary approximately proportionately with the size of the Frisch elasticity. In addition, the ratio of longer-term benefits from delayed tax cuts to short-term losses rises when consumption is less sensitive to real interest rates as it induces a larger fall in the real interest rate and a greater rise in the capital stock. This occurs when the intertemporal elasticity of consumption is reduced and when forward-looking consumers are made more impatient. Increasing the elasticity of substitution between labor and capital also raises this ratio as it increases the response of the capital stock to changes in labor supply. Finally, changing the proportion of rule-of-thumb consumers had little impact on the path of real GDP (and is not reported).

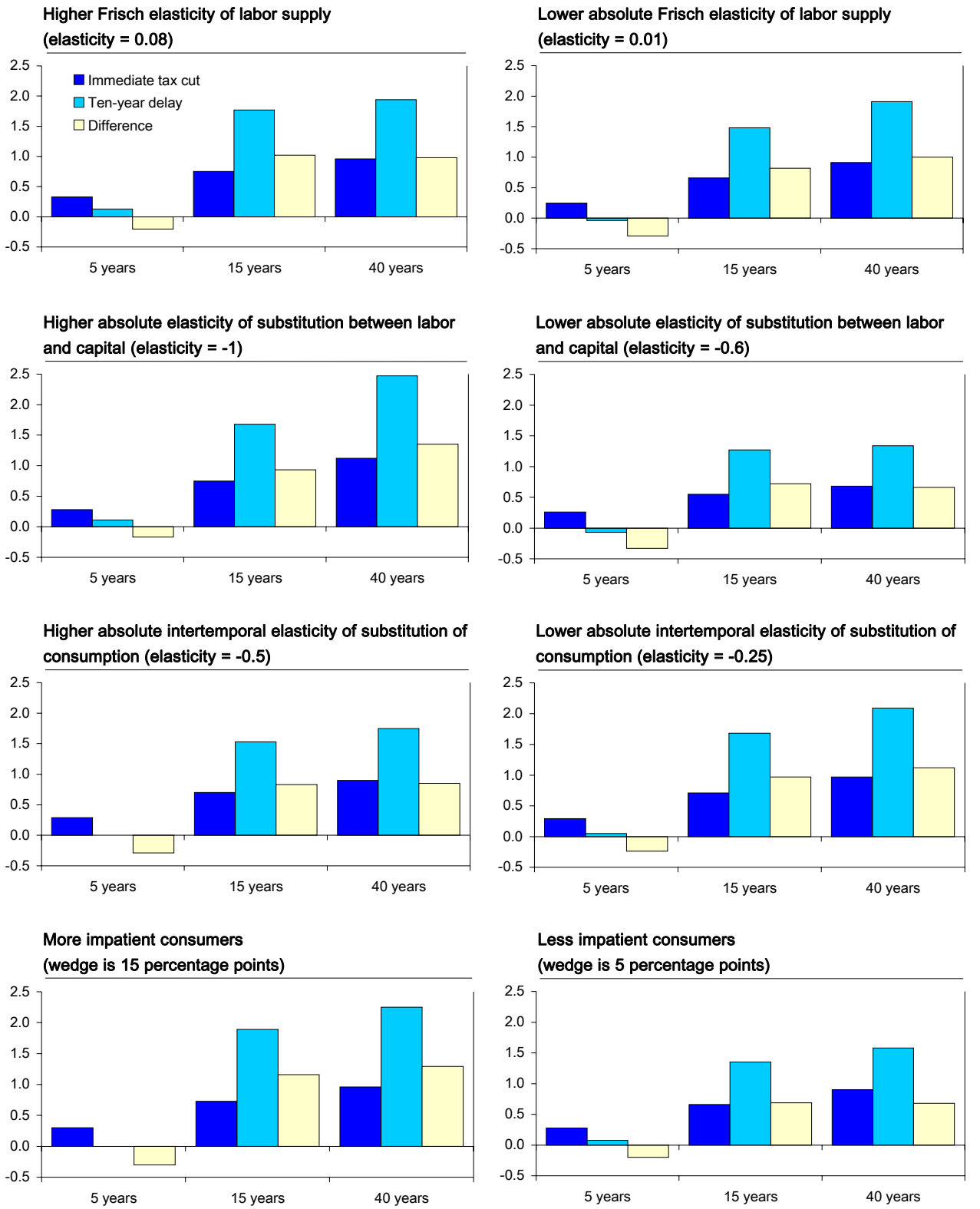
14. ***The key parameter for a corporate income tax is the elasticity of substitution between capital and labor, while changes in the sensitivity of consumption to real interest rates again matter for the dynamic responses*** (Figure 4). The higher the elasticity of substitution between labor and capital, the greater the incentive for firms to respond to a tax cut by raising the capital stock, and hence the larger the benefits of a delayed tax cut. In addition, the larger impact on the real interest rate from reducing the sensitivity of consumption to the real interest rate again raises the dynamic benefits of a tax cut. By contrast, changes in the Frisch elasticity and the proportion of rule-of-thumb consumers have little impact on the simulations.

D. Fiscal Spillovers

15. ***The model can also be used to examine issues of fiscal spillovers across countries***. As in the earlier section, a highly stylized scenario designed to illustrate the impact of tax competition on the Canadian economy is examined. In particular, it is assumed that there is a wage or corporate income tax rate cut in the rest of the world that lowers revenues by a percentage point of GDP and leads to larger fiscal deficits. After 5 years, this tax cut is rescinded and replaced by a permanent tax rate increase that generates sufficient revenues to cover the additional interest costs incurred by the intervening rise in government debt. The simulations first examine the impact on the Canadian economy assuming no response by the tax authorities, and then the results if the Canadian authorities follow the rest of the world in cutting, and then later raising, the same tax rate.

Figure 4. Effects of Alternative Parameterizations on Impact of a Cut in Transfers and in the Corporate Income Tax Rate on Real GDP

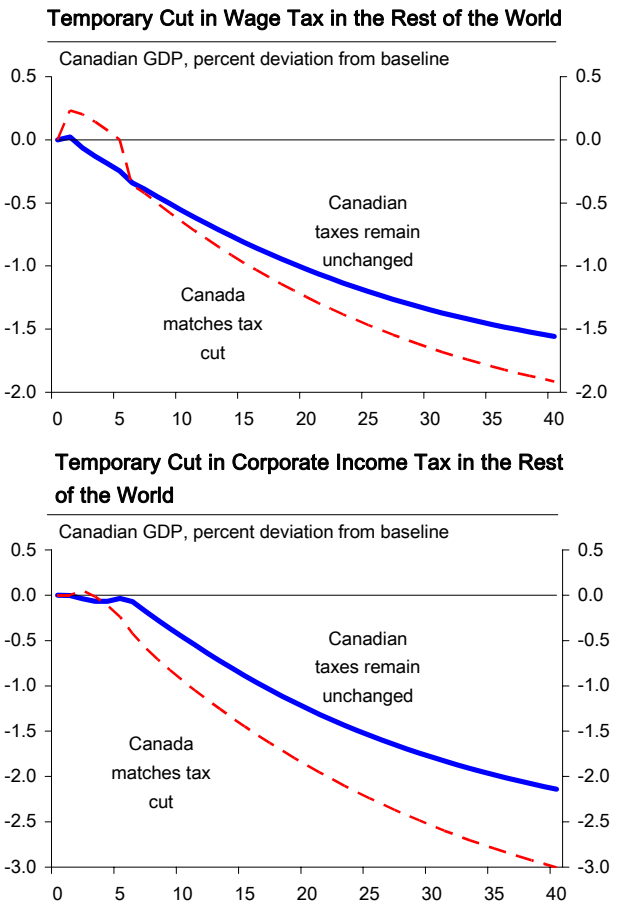
(percent deviation from baseline)



Source: Fund staff calculations.

16. ***The results suggest that fiscal spillovers from tax cuts in the rest of the world can be significant and rise over time*** (Figure 5). A temporary cut in wage taxes in the rest of the world equivalent to a one percentage point of their GDP is followed by subsequent increase of the order to one-quarter of this amount. The loss to Canadian and global GDP is of the order of three-quarters of a percent after 15 years. The losses accumulate gradually over time, as global real interest rates rise by around a half percentage point and crowd out investment in response to the 8 percentage point of GDP increase in rest of the world government debt.[32] The resulting losses to real GDP for equivalent changes in corporate income taxes are somewhat larger, reflecting the fact that corporate tax rate increases are more distortionary, but the basic mechanisms are similar.

Figure 5. Impact of Tax Spillovers from the Rest of the World



Source: Fund staff calculations.

17. ***The Canadian government can mitigate the medium-term effects of fiscal spillovers by matching foreign taxes cuts, but only at the cost of larger long-term costs to real GDP***. These results broadly mirror those found earlier about the benefits and costs of immediate and delayed tax cuts. However, as the main effect on Canada occurs through the global rate of interest, rather than differences in tax rates across countries, Canada's own tax policy has only a limited impact on the long-term losses in output. This observation applies more to wage tax cuts than corporate income tax cuts, as the latter involve larger domestic distortions.

18. ***These results reflect a range of assumptions about the structure and behavior of the global economy***. It should be emphasized that the impact of fiscal policies in individual countries would be smaller for the rest of the world, as they would have a lesser impact on global debt and real interest rates. In addition, the size of fiscal spillovers is an area of

[32] This is broadly consistent with results reported in IMF (2004), which finds that a percentage point rise in the U.S. fiscal deficit raises interest rates by up to ½ percentage point (i.e. recalling that the United States represents about one-third of global GDP at market prices), as well as the rule of thumb of Elmendorf and Mankiw (1999), that are rise in government debt lowers the capital stock by an approximately equal amount.

considerable controversy, and these simulations are only one approach to answering this question.[33]

E. Conclusions

19. ***The conclusions of this analysis can be summarized as follows***:

- ***There are significant potential benefits to reducing government debt by delaying tax cuts***. In the base case, delaying tax reductions 10 years at the costs of short-term losses in output doubles the medium-term gains to real GDP of the eventual tax cut and the long-term benefits can be even larger.

- ***A corporate income tax cut provides significantly greater benefits over time than a wage tax cut***. This is because capital is a more mobile factor of production, and hence more responsive to changes in incentives.

- ***The key parameters that determine the benefits of delaying tax cuts are the Frisch elasticity of labor supply for a wage tax and the elasticity of substitution between labor and capital for a corporate tax cut***. In addition, the ratio of losses and benefits to real GDP rise as the response of consumption to real interest rates is reduced or consumer impatience rises, as this boosts the long-term impact on the capital stock.

- ***International fiscal spillovers can be significant, with much of the impact coming through the global rate of interest, rather than differences in tax rates across countries***. This limits the effectiveness of Canadian policies in reducing these spillovers, particularly for wage taxes.

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IV. How Do Canadian Budget Forecasts Compare With Those of Other Industrial Countries?[34]

A. Introduction and Summary

1. ***Canada's strong fiscal record in recent years rests on a proven budgetary framework, including a well-established forecasting process***. Canadian public finances are highly transparent, and the government's policy of achieving "budget balance or better" enjoys widespread public support. In place for almost a decade, the framework has produced a string of budget surpluses that have helped reduce federal debt (measured by the accumulated deficit) from almost 70 percent of GDP in 1996 to close to 40 percent in 2004. Following that success, the forecasting process is currently being reviewed to ensure that "the [federal] government continues to use the most up-to-date economic and fiscal forecasting methods, and to benchmark Canadian practices against the best in the world" (Department of Finance, 2004, p. 67).

2. ***This paper compares Canadian central government budget forecasting with other industrial countries***. The benchmark group consists of most other G-7 countries, plus Australia and New Zealand (two commodity exporting countries), and with the Netherlands, Sweden, and Switzerland representing smaller industrial countries with advanced budget practices.[35] The paper follows a two-pronged approach, covering both structural and quantitative aspects. Sections B and C compare the institutional environment for fiscal forecasting and forecasting processes across the benchmark group. Section D provides a description of budgetary forecast outcomes, and section E presents the results of statistical analyses that, among others, test for forecast bias and identify links between structural characteristics and forecast errors.

3. ***The study finds fiscal forecasting in Canada governed by one of the strongest institutional frameworks relative to benchmark countries***. Although Canada has no formal fiscal rule, the policy of "balance or better" has evolved into a *de facto* fiscal target. In support of this objective, Canada has adopted a conservative approach to budgeting, with explicit prudence and contingency factors and a strong commitment to transparency and accountability. One particular strength is the explicit use of macroeconomic projections from a wide range of private forecaster for the preparation of the budget. However, forecasts of fiscal variables are compiled by the Department of Finance with little participation of non-governmental agencies. As is the case with many other countries, Canada could enhance the

[34] Prepared by Martin Mühleisen, Stephan Danninger, David Hauner (both FAD), Kornélia Krajnyák, and Ben Sutton. We are grateful to our colleagues in the participating countries as well as in the Fund's European and Asia and Pacific Departments for their cooperation in acquiring and analyzing the data for this study.

[35] Japanese fiscal policy in the mid- to late 1990s was largely implemented through supplementary budget requests, which would complicate a comparison of its budget projections with other countries. Japan was therefore not included in the benchmark group.

understanding of budgetary forecasts by providing more information on the assumptions and methods underlying the translation of the macroeconomic outlook into fiscal projections.

4. ***Quantitative analysis suggests that budget projections of macroeconomic and fiscal aggregates have been more cautious than in other countries since the mid-1990s***. Measures for the distance between budget projections and actual outcomes were among the highest within the benchmark group. Moreover, forecast errors for both revenue and expenditure aggregates were consistently on the conservative side, making Canada the country that on average most strongly underestimated its fiscal balance since 1995. Empirical tests indicate that the forecast errors are significantly different from zero, and that both public and private forecasters were repeatedly surprised by the strength of the Canadian economy and fiscal performance, particularly in the late 1990s. Indeed, given the close link between tax revenues and the macro economy, stronger-than-expected growth appears to account for a considerable part of fiscal overperformance. The relatively volatile macroeconomic environment as well as institutional factors have also likely contributed to Canada's conservative forecast bias.

B. The Institutional Environment for Budget Forecasts

5. ***A country's budget forecasting practices depend importantly on the legal and institutional structures governing fiscal policy***. These structures need to be taken into account when comparing forecasting practices across countries, particularly as they can influence the accuracy of budget projections in a number of ways. This section looks at three factors characterizing the fiscal environment: first, the distribution of fiscal authority between the legislature and the executive; second, fiscal relations between the central and sub-national governments; and third, the presence of fiscal rules and other constraints limiting fiscal policy discretion.

Distribution of fiscal authority

6. ***The distribution of fiscal authority between the executive and legislative branch may affect the nature and quality of budget forecasts***. For example, if substantial fiscal authority rests with the legislature, policy assumptions underlying the fiscal forecast of the executive branch may turn out to be different from fiscal measures taken, and the forecast quality could correspondingly suffer. Alternatively, the executive could face incentives to produce biased forecasts in order to influence the behavior of the legislature. For example, the executive could provide conservative revenue forecasts to keep spending pressures under control. By contrast, there would *a priori* appear to be fewer incentives for biased forecasts in cases where the legislature tends to approve the budget as drafted.

7. ***In Canada, the legislature has largely been focused on optimizing the budget process, as opposed to taking an active role in the formulation of the budget***. The budget process reflects international best practices in many areas. For example, an OECD/World Bank survey (OECD/WB, 2003) finds that 19 out of 20 key aspects of the Canadian budget process are regulated by the constitution or by law (Table 1). Among the countries in the

Table 1. Indicators of Relations Between Legislature and Executive

	Australia	Canada	France	Germany	Italy	Nether-lands	New Zealand	Sweden	U.K..	U.S.
Aspects of budget process regulated by the constitution or by law										
Public funds can only be spent in programs as authorized by legislation	x	x	x	x	x	x	x	x	...	x
The budget and financial reporting covers all central government transactions (including extrabudgetary transactions)	x	x		x	x	x		x	...	x
All budget transactions to be shown in gross terms	x		x	x	x	x		x	...	
The minister in charge of government finances has effective power over budget management	x	x	x	x		x	x		...	x
Individual government organizations are held accountable for the funds they collect and/or use	x	x		x		x	x		...	x
Individual Ministers are held accountable for the funds they collect and/or use	x	x		x	x	x	x		...	x
Requirements for independently audited financial accounting reports	x	x		x		x	x	x	...	x
Requirements for independently audited non-financial reports		x	x			x		x	...	x
Conditions for use of contingency or reserve provisions		x	x	x	x				...	x
Definition of public money	x	x	x	x	x	x	x	x	...	x
Rules for the creation of extra-budgetary funds to special cases, authorized by separate statute	x	x	x	x		x		x	...	x
Authorize the government accounts into which all public money must be paid and from which expenditures are made only by appropriation of the parliament	x	x	x	x	x	x	x	x	x	x
Roles for the parliament and the executive in the budget process and the relationship between the two branches with respect to budget responsibilities	x	x	x	x	x	x	x	x	...	x
The form and structure of the annual budget law (or finance bill) to be voted by parliament	x	x	x	x	x	x	x		...	x
The definition of main headings and accounts in the annual budget law	x	x	x	x	x		x	x	...	x
The definition of the budget deficit and surplus	x	x	x	x	x		x	x	...	x
Legal basis for formulation and execution of the budget, including the role and authorities of the Ministry of Finance/Treasury and/or the Central Budget Authority		x	x	x	x	x	x		...	x
Administrative/judicial sanctions for infractions of budget legislation	x	x	x		x		x		...	x
The basis for management (internal) control and internal audit	x	x	x	x	x	x	x		...	x
Authorities and responsibilities for issuing and reporting on government guarantees	x	x	x	x		x	x	x	...	x
OECD Best Practices on central government budget reporting met										
General overview of revenue and expenditure	x	x	x	x	x	x	x	x	x	x
Detailed estimates of revenue and expenditure		x	x	x	x	x	x	x	x	x
Citizen's guide			x	x				x		
Pre-budget report (general budget policy, aggregates)	x	x	x		x		x		x	
Long term (10 to 40 year) outlook for public finances	x						x		x	x
Mid year report(s) on fiscal outlook	x	x	x		x		x	x	x	x
Report on tax expenditures		x	x	x		x	x	x	x	x
Statement of government assets	x	x			x	x	x	x	x	x
Special reports for old-age programs finances		x	x	x				x		x
Special reports for civil service pension		x	x	x				x		x
Special reports on government debt		x	x			x	x			x
Special reports on contingent liabilities		x					x			x
Pre-election report	x						x			
Number of months budget is submitted to legislature before the new fiscal year	<2	<2	2-4	4-6	2-4	4-6	<2	2-4	<2	>6
Percentage share of expenditure for which appropriation acts need to be passed	20-30	30-40	...	90-100	...	90-100	90-100	90-100	70-80	30-40

Source: OECD/WB (2003).

benchmark group, only the United States achieves a similar score.[36] Moreover, Canada adheres to ten out of 13 OECD Best Practices in budget reporting, which is matched only by New Zealand and the United States.

8. ***Canadian budgets are usually passed without any changes when submitted***. This appears a common feature in Westminster-style parliamentary systems, and in other countries where the executive enjoys reliable support in the legislature. Similar practices are followed in Australia, New Zealand, the United Kingdom, but also in Sweden (OECD/WB 2003). The role of Canada's parliament is circumscribed by the following:

- ***Parliament receives the budget relatively late, less than two months before the start of the new fiscal year***. A quarter of the fiscal year has typically elapsed by the time the budget is approved. In contrast, legislatures of other countries receive the budget two to six months before the new fiscal year, and even earlier in the United States. The late budget submission may be partly attributable to the use of accrual accounting, which requires information that becomes available late in the fiscal year.

- ***Only a relatively small part of total expenditure is funded by appropriation laws***. As mandatory spending in Canada does not require annual funding legislation, new appropriations cover only about 30−40 percent of spending. This is similar to arrangements in Australia and the United States, but contrasts sharply with other countries. In the United Kingdom, appropriation laws cover 70–80 percent of total expenditure, and coverage can reach 90−100 percent in Continental Europe.

- ***As in many parliamentary systems, the Canadian legislature has limited powers to change the submitted budget***. Parliament can reduce, but not increase, funding for line items, but has otherwise only the choice of approving or rejecting the government's spending proposals. Only parliaments in Australia and New Zealand—which have to approve or reject the budget as a whole—are more constrained. Some restrictions also apply in France and Switzerland, while legislatures in Germany, Italy, Netherlands, Sweden, and the United States are free to change every aspect of the budget proposal.

- ***The executive would suffer strong consequences if parliament voted against any budget proposal***. The budget vote is considered a vote of confidence in many countries, but political tradition in Canada (as in Australia, New Zealand, and the United Kingdom) goes further. In these countries, the executive customarily would have to step down if parliament voted against any single aspect of the budget (Blöndal, 2002).

9. ***As a result, there is little indication that executive-legislative relations should affect the accuracy of Canadian budget forecasts more than in other countries***. The legislature's

[36] Switzerland was not part of the OECD/World Bank survey.

limited role in the annual budget process appears to provide few incentives for providing biased forecasts; it also constrains the potential loss of forecast quality resulting from modifications prior to passage. At the same time, relatively stringent process rules and reporting requirements would seem conducive to forecast accuracy.

Fiscal relations with sub-national governments

10. ***The structure of intergovernmental relations also has implications for budgetary forecasting***. From a technical perspective, the volatility of fiscal outcomes at the center is likely higher if significant transfers to the sub-national levels are provided on a cost-sharing rather than a block-grant basis, given the scope for ex-post adjustments. However, there are also circumstances that may contribute to a deliberate bias in fiscal projections, such as when fiscal targets are set at the general government level but the central government has limited control over the behavior of sub-national governments.

11. ***While Canadian provinces enjoy substantial financial independence, transfers to provinces account for an important share of central government spending***:

- ***The center's share in general government is smaller in Canada than in any of the comparator countries***. Combined, Canada's sub-national governments are about as large as the central government (Table 2). This reflects the comparatively high number of policy responsibilities falling on sub-national governments, including the country's universal health care system.

Table 2. Share of Spending by Sub-National Governments[1]

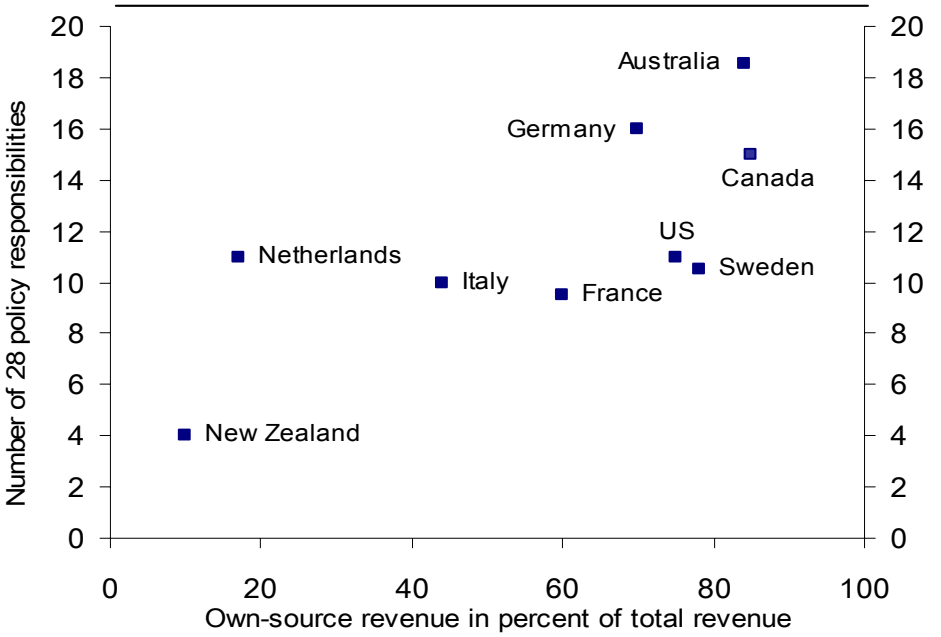
Federal countries	
Australia	n.a.
Canada	56.5
Germany	36.1
Switzerland	n.a.
US	40.0
Unitary countries	
France	18.6
Italy	29.7
Netherlands	34.2
New Zealand	n.a.
Sweden	43.4
UK	25.9

Source: OECD, 2003, *Economic Studies* , No. 36.

[1] Percent of general government spending. National accounts basis, 2001.

- ***Provinces have a high share of own-source revenues*** (85 percent), including from tax revenues shared with the central government (Figure 1). They are also free to determine their overall fiscal aggregates as well as most expenditure allocations—among the benchmark countries, only the sub-national governments in Sweden and

Figure 1. Influence of Sub-National Governments



Source: OECD/WB (2003).

the United States have as much leeway. Canadian provinces can also borrow without federal limits—as in France, the Netherlands, New Zealand, and Sweden.[37]

- ***However, transfers to other levels of government are a more important budget item in Canada than other benchmark countries***.[38] Intergovernmental transfers are substantial even when compared to GDP, and the relatively small size of the center further inflates their size relative to other federal expenditures (Table 3).

12. ***Uncertainties about revisions to the level of intergovernmental transfers and shared tax revenues may have posed difficulties for fiscal forecasting***. Fiscal arrangements in Canada provide for considerable payments flowing from the federal government to the provinces. Under some arrangements, the final amounts are usually not determined by the end of a given fiscal year, giving rise to adjustments in subsequent years. Due to the

[37] See OECD/WB (2003). In the United States, many states have fixed limits in their constitutions. Similar to most comparator countries, the Canadian federal government does not guarantee the debt of sub-national governments.

[38] Equalization transfers (to reduce economic disparities among provinces) and transfers for health and social spending are the most important transfers, amounting to 1 and 3 percent of GDP, respectively. In 2004, the government reached an agreement with the provinces to place equalization transfers on a more predictable basis, including by eliminating retroactive adjustments to the overall amount of transfers provided.

Table 3. Consolidated Central Government Expenditure Shares, 2003[1]

(in percent of total expenditure)

	Australia	Canada	France[2]	Germany	Italy[3]	Netherlands	New Zealand	Sweden[2]	Switzerland	U.K.[2]	U.S.	Rank Canada
General public services	26.6	30.3	7.7	13.7	20.6	22.1	9.0	23.5	14.3	5.2	12.2	1
of which:												
Public debt transactions	5.0	9.4	5.9	5.8	13.9	5.5	5.4	7.4	3.6	...	9.2	2
Defense	6.5	5.8	5.2	3.6	2.6	3.6	2.9	5.7	4.9	7.4	19.1	4
Public order and safety	0.9	3.0	1.7	0.4	4.4	3.7	4.1	3.2	0.6	5.1	1.4	6
Economic affairs	6.2	6.0	10.0	6.7	5.7	6.0	6.8	9.4	11.5	6.9	7.0	8
Environment protection	0.2	0.6	0.2	0.1	1.7	0.4	0.0	0.5	...	...	...	3
Housing and community amenities	0.7	1.3	1.0	0.9	1.7	0.5	1.5	0.6	0.8	1.3	2.0	4
Health	14.2	2.7	16.9	19.3	12.7	10.4	16.5	2.9	21.1	16.4	23.4	10
Recreation, culture and religion	0.9	1.5	0.7	0.1	2.0	0.9	2.2	0.8	0.5	1.4	0.2	4
Education	9.3	2.1	10.0	0.4	10.5	10.8	21.2	6.4	2.6	12.5	2.6	9
Social protection	34.5	46.6	44.3	54.8	38.2	41.5	35.9	47.2	43.7	42.5	32.0	3
Memorandum item:												
Transfers to sub-national governments[4]	27.2	31.4	8.6	14.3	12.9	26.1	1.0	13.7	27.5	19.1	19.1	1

Sources: *IMF Government Financial Statistics* , *OECD Revenue Statistics* , and Fund staff calculations.

1/ Data are provided on a comparable basis, and therefore not necessarily consistent with central government figures as reported by individual countries.

2/ 2002. UK: General government.

3/ 2000.

4/ Includes general and earmarked transfers. Data for Italy and the UK are from 2000, for Sweden, Switzerland and the US from 2001, and from 2002 for the rest.

relatively large size of transfers relative to other government expenditures, revisions can sometimes have a notable impact on the federal fiscal forecast:

- ***The amount of equalization transfer payments was until recently subject to considerable uncertainty***. Equalization transfer are provided as unconditional block grants. However, prior to a 2004 agreement between the federal government and the provinces, the size of these transfers was subject to significant ex post adjustments, owing to statistical revisions of provincial tax bases and population size (Box 1).

- ***Ex-post adjustments also arise from the federal government collecting tax revenue for some provinces and the Canada Pension Plan*** (CPP). The central government collects personal and corporate income taxes on behalf of nine and seven provinces, respectively, as well as CPP payroll contributions. These collections represent about 35 percent of federal revenue. Gross income and payroll tax revenues are divided on a preliminary basis throughout the year, but the actual split is only known after all relevant tax returns are assessed—usually toward the end of the following fiscal year.

Fiscal rules and other constraints

13. ***Fiscal policy rules may improve fiscal discipline, but the costs of violating budget targets may also lead to cautionary biases***. Governments that face incentives to improve their budget planning and implementation process by implication have better prospects of meeting fiscal forecasts.[39] On the other hand, asymmetric consequences of not meeting budget targets may lead to the incorporation of both explicit and implicit prudence factors in the forecast (e.g., Zellner, 1986).

14. ***Unlike in many other countries, fiscal policy in Canada is not constrained by budget rules legislated by the constitution or by law*** (Table 4).[40] Most advanced countries have adopted some form of rule, which could include targets for both the overall balance and expenditure, and require embedding fiscal plans within a medium-term framework.[41] The monitoring of these objectives is usually accompanied with rigorous reporting requirements comparing ex ante plans with ex post outturns. For example, the EU Commission mandates that Stability Reports include a section on the general economic policy strategy, macroeconomic forecasts and budgetary projections, as well as a series of standardized tables to enable the evaluation of the projections. In Australia, New Zealand, and the United Kingdom, fiscal planning is guided by legislation specifically aimed at enhancing transparency and accountability.

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[39] For example, the introduction of fiscal policy constraints in euro area countries led to the adoption of binding multi-year targets, supplemented with more detailed descriptions of countries' fiscal plans.

[40] The "Fiscal Spending Control Act" was in force only between 1991 and 1994.

[41] See Kopits and Symansky (1998), and Dában, *et al*., (2003) for a detailed discussion of fiscal policy rules. The Stability and Growth Pact (SGP) mandates that deficits do not exceed 3 percent and a debt-to GDP ratio of less than 60 percent. Medium-term targets must be authorized by the legislative in Italy and the United States.

Box 1. Equalization Transfers in Canada[1]

Equalization transfers are designed to reduce disparities in tax-raising capacity between provinces. The transfers are being provided as general purpose block grants, channeling federal funds to provinces with below-average revenue raising capacity. The definition of "revenue raising capacity" is based on a comparison between per capita revenue raised and the per capita revenue each individual province could raise if it levied national average tax rates on each of the sources of provincial revenue. Each province's revenue raising capacity is then compared to that of the average of the five middle income provinces (British Columbia, Manitoba, Saskatchewan, Ontario and Québec) on a per capita basis. Total equalization entitlements are determined as:

$$\sum_j E_{ij} = \sum_j \tau_j (\overline{B_j} / \overline{P} - B_{ij} / P_i) \cdot P_i$$

where E_{ij} = entitlement under revenue source j in province i
B_j = the tax base for revenue source j in the representative provinces
P = the population of the representative provinces
B_{ij} = the tax base for revenue source j in province i
P_i = the population of province i
τ_j = the national average tax rate for revenue source j

The size of equalization transfers was subject to considerable uncertainty. Initially, inputs to the formula determining entitlements are based on estimates for the current fiscal year. As these data are revised in subsequent years—for example, if a new census is taken or final tax revenue data become available—entitlements are modified and positive or negative ex-post payments are made (see Table). Over the past four years, i.e., between FY 2000−01 and FY 2003−04, the magnitude of ex-post adjustments ranged between -21 percent to 8 percent of annual transfers, equivalent to a margin of up to 1/8 percent of GDP.

In October 2004, the government announced a new Equalization framework. This included a new legislated level of overall Equalization entitlements starting in 2005-06, with a built-in growth rate of 3.5 percent annually.

Calculation of 2000-01 Equalization Transfers (in billions of Canadian dollars)

	Nfld.	P.E.I.	N.S.	N.B.	Que.	Man.	Sask.	Total
Payments through February 2001	1.0	0.2	1.2	1.1	4.3	1.1	0.1	9.0
Third estimate (February 2001)	1.1	0.3	1.3	1.2	5.4	1.2	0.2	10.8
Fourth estimate (October 2001)	1.1	0.3	1.3	1.2	5.4	1.2	0.3	10.8
Fifth estimate (February 2002)	1.1	0.3	1.4	1.3	5.2	1.3	0.3	10.8
Sixth estimate (October 2002)	1.1	0.3	1.4	1.3	5.3	1.3	0.2	10.9
Seventh estimate (February 2003)	1.1	0.3	1.4	1.3	5.3	1.3	0.2	10.9
Final estimate (September 2003)	1.1	0.3	1.4	1.3	5.4	1.3	0.2	10.9

Source: Department of Finance.

[1] This Box relies on Krelove, *et al*. (1997).

Table 4: Fiscal Policy Rules and Transparency Laws

	Type of rule			
	Deficit/Debt	Golden rule	Expenditure ceiling	Fiscal Transparency Law
Australia	--	--	--	Yes
Canada	--[1]	--	--	--
France	SGP[2]	--	--	--
Germany	SGP[2]	Yes	--	--
Italy	SGP[2]	--	--	--
Netherlands	SGP[2]	--	Real	--
New Zealand	--	--	--	Yes
Sweden	2 % surplus	--	Nominal	--
Switzerland	--	--	Nominal	--
United Kingdom	Debt	Yes	--	Yes
United States	--	--	--	--

Source: IMF staff.

[1] Canada has adopted a fiscal target of "balance or better" over the past 10 years. The target is supported by a strong public consensus, providing many of the characteristics of a fiscal rule.

[2] SGP: Stability and Growth Pact (3 percent deficit and 60 percent debt ceiling).

15. ***However, Canada has adopted a* de facto *fiscal rule of budget balance or better, with performance observed on a relatively stringent basis***. Beginning in 1998, the authorities defined specific fiscal targets aimed at achieving budget balance or better. The political commitment to this target, whose asymmetry was derived from long-term fiscal sustainability considerations, gives it a role similar to quantitative fiscal policy targets in a rules-based system. However, the target appears stronger than in many countries, both because performance is observed on an annual basis instead over the medium-term, and because the target is expressed in nominal terms and thus more difficult to achieve during a downturn than a GDP ratio. Forecasting performance is also closely monitored and plays an important role in assessing the government's track record in implementing its policy plans.

16. ***Canada also adheres to a strict budget planning framework***. Along with the adoption of new fiscal targets, fiscal forecasting practices were fundamentally overhauled in the mid-1990s. A key objective of these reforms was to improve the credibility of economic and fiscal forecasts in response to a rapid build-up of public debt. Financial markets had begun to discount the government's fiscal policy plans after economic assumptions had turned out to be consistently over-optimistic. A summary description of the current organization of the forecasting process is given in Box 2.

Box 2. Fiscal Forecasting Arrangements in Canada

In 1994 and 1995, Canada implemented significant changes to the budget formulation process. The government adopted a new public expenditure management system, a two-year rolling planning horizon was introduced, and the forecasting process revamped. This system was refined in 1999 by publishing five-year fiscal forecasts in the fiscal mid-year reports, and by being more explicit about prudent planning assumptions in fiscal forecasts.

For the *macroeconomic forecast,* the Department of Finance surveys approximately 20 private sector forecasters each quarter after the National Accounts are released. Average annual private sector forecasts of real GDP growth, inflation, labor market indicators, and interest and exchange rates form the basis of the government's macroeconomic assumptions. To ensure model consistency, the Department may refine these assumptions in meetings with outside economists. The Department feeds the assumption thus gained into its internal macroeconomic model (the Canadian Economic and Fiscal Model) to construct aggregate revenue and expenditure projections consistent with the private-sector forecast.

The detailed *revenue and expenditure forecast* is produced by the Department of Finance and respective spending agencies. Within the Finance Department, it is principally the Fiscal Policy Division that generates the revenue and expenditure forecasts. Some smaller elements of the revenue forecast, for example, the value added tax low-income rebate, are forecast by the Department's Tax Policy Branch using micro-simulation models. Similarly, the Department's Economic Development and Corporate Finance Branch and certain Crown corporations are also consulted and provide information to help formulate the non-tax revenue component of the revenue forecast. Other departments provide spending forecasts based on three-year business plans, which are reviewed by the Treasury Board Secretariat.

Since 1999, five-year fiscal forecasts have been prepared by private sector forecasters, and are published in the *Economic and Fiscal Update* published in the fall. These forecasts cover broad fiscal aggregates on a general government basis. Based on this forecast, central government projections are again provided by the Department of Finance, with the 2004 Update presenting details on how the central government data have been derived from the private sector's general government forecast.

17. ***Canada has placed significant emphasis on prudent forecasts, which could have affected forecast accuracy*.** While macroeconomic forecasts are obtained from a panel of private sector forecasters, fiscal forecasts contain an explicit cautionary bias—the so-called prudence factor.[42] In addition, the budget includes a contingency reserve to cushion against unforeseen economic developments. In 2004, the prudence factor and the contingency reserve amounted to C$1 billion and C$3 billion, respectively, for both the 2004–2005 and 2005–2006 budget projections. If the contingency reserve remains unutilized, it is used to pay down debt. Although on a smaller scale than in Canada, the use of cautious economic assumptions or specific reserves can also be found in other countries (for example, in the

[42] From the 1994 Budget to the 1998 Budget, prudence was incorporated into the fiscal projections by explicitly adopting economic assumptions that were more pessimistic than the average of the private sector economic forecasts, including higher interest rates and weaker economic growth.

United Kingdom and the Netherlands). In the Netherlands, formal arrangements have also been in place for the utilization of funds from unexpected over-performance of the fiscal balance (Blöndal and Kristensen, 2002).

18. ***In addition to fiscal rules, expenditure discretion in Canada is constrained by relatively high debt service costs and other nondiscretionary expenditure***. In particular, the share of interest payments is the second-highest among the eleven countries, despite the recent decline in public debt, while the share of social protection is the third-highest (see Table 3).[43] Moreover, as noted before, the share of transfers to other levels of government is far higher in Canada than in most benchmark countries.

C. Fiscal Forecasting Practices in International Comparison

19. ***The importance of fiscal forecasts for budget planning purposes raises process and transparency issues***. While solid technical capacities are a necessary ingredient to high-quality forecast outcomes, forecasting performance also tends to be boosted by an open budget preparation process, including the involvement of non-governmental agencies, public access to information, and regular reviews of forecasting performance (IMF, 2001). This section contrasts technical aspects of Canada's fiscal forecasting arrangements with other countries, and assesses its transparency aspects.

20. ***The role of fiscal forecasts in the Canadian budget process is similar to practices in other benchmark countries*** (Table 5).[44] In the majority of surveyed countries, the responsibility for budget preparation is assigned to one government agency (the Ministry of Finance or Treasury), but usually carried out in collaboration with other government agencies. Forecasts are framed within a medium-term horizon in all countries, mostly in the form of a rolling three- to five-year forecasting framework (e.g., euro area countries are required to prepare indicative 5-year fiscal plans). However, the period for which fiscal plans are binding, or for which greater detail is presented, is typically much shorter. In Canada, budget preparation is based on a 2-year framework, although the government since 1999 also prepares five-year fiscal forecasts as part of the mid-year fiscal update.

21. ***Canada relies more than other countries on macroeconomic forecasts by private forecasters*** (Table 6; see also Box 2). In most benchmark countries, the agency responsible for the budget develops its economic forecast in-house, using econometric and spreadsheet-based models. These estimates are often supplemented with information gained from consultations with non-governmental forecasters or the business sector. In some cases, no outside agencies are formally involved at all, and quality control is left to benchmarking

[43] The share of interest payments has come down from 20 percent in 1990 to 9 percent in 2003.

[44] Sources for this information include country responses to a short staff questionnaire, an OECD/World Bank survey on budget institutions (OECD/WB, 2003), and available IMF Fiscal ROSC reports. The questionnaire covered the development and organization of the forecasting process, as well as arrangements for quality control and transparency.

Table 5. Key Institutional Characteristics of the Fiscal Forecasting Process

			Characteristics of the forecasting process	
	Budget authority	Forecasting horizon 1/	Macro-economic forecast	Revenue and expenditure
Australia	Treasury, Department of Finance and Administration	Rolling three year	MOF intern based on extensive consultation process	Government internal; revenue: derived from interaction between spreadsheet based forecast and econometric model; expenditure: supplied by spending agencies
Canada	Finance Department and Treasury Board Secretariat	Rolling two year budget forecasts; aggregate fiscal forecasts for 5 years	Average of private forecasters	Revenue and expenditure : two-year budget forecast prepared internally by experts group and respective spending agencies; five year-forecast in mid year based on forecast of private sector
Germany	Ministry of Finance	Five year (SGP)	MOF intern after consultations with forecasting agencies	Revenue: based on consensus among expert group with non-governmental participation; expenditure: government internal supplied by spending agencies
Netherlands	Ministry of Finance	Rolling three year budget forecast; five years at aggregate level (SGP)	Independent public agency for coalition period; MoF otherwise	Revenue: by independent public agency for four year coalition plan; MoF internal revenue forecast for individual budget years, expenditure forecasts by spending agencies;
Sweden	Ministry of Finance	Rolling three year budget forecast; five years at aggregate level (SGP)	MoF intern: model driven benchmarked against other public sector forecasters	MOF internal; revenue model driven benchmarked against other public sector forecasters; expenditure: prepared by spending agencies
Switzerland	Ministry of Finance	Rolling three year budget forecast	Forecast by expert group comprising MoF, central bank and statistical office.	Government internal; revenue: iterative process between different departments in the Ministry of Finance; expenditure: supplied by spending agencies
U.K	Treasury	Five year budget forecast; aggregate long-term projections	Treasury: iterative process between econometric model and micro based fiscal forecasts	Government internal; revenue: iteration between treasury' macro model and micro based expert models in revenue department; expenditure: prepared by spending agencies
France	Ministry of Finance	Five year (SGP)	Ministry of Finance: Forecasting Directorate.	Government-internal; revenue: iteration between various departments in the MoF; expenditure: forecasts made by the MoF's Budget Directorate in coordination with spending ministries.
Italy	Ministry of Finance and Economy	Five year (SGP)	…	…
New Zealand	Treasury	Four year budget forecast	Iterative spreadsheet based forecast including views of expert panel, business, and senior staff from Treasury	Government internal: two revenue forecasts prepared and published separately by Treasury and revenue administration; based on micro and macro-models with consistency check with macroeconomic forecasts and assessment against views of practitioners (tax talks); Treasury forecast used in budget; expenditure forecasts prepared by spending agencies
U.S.	White House (Office of Management and Budget)	Five year budget forecast	…	President's forecast assessed by congressional budget office leading to congressional budget resolution that establishes major fiscal aggregates to constrain the decision-making of the appropriations, taxing, and authorizing committees.

Source: OECD and World Bank (2003), country authorities, and IMF country desks.

1/ Includes budget year.

Table 6. Fiscal Forecasting: Quality Assurance

	Involvement of non-government agencies 1/		Ex-post assessment of forecasting performance 2/		Availability of information on fiscal performance 3/
	Macro forecast	Revenue forecast	Self	External	Score on detail and regularity
Australia	Medium	Low	Regular	Occasional	Medium
Canada	High	Medium	Regular	Occasional	High
Germany	Medium	High	Occasional	Occasional	Low
Netherlands	Medium	Medium	Regular	No	Low
Sweden	Low	Low	Occasional	No	Low
Switzerland	Low	Low	Occasional	Occasional	...
U.K.	Low	Low	Regular, legal	Regularly	High
France	Medium	Low	Regular	Regular	High
Italy	Low	Low	...	No	Low
New Zealand	Medium	Medium	Regular	Occasional	High
U.S.	...	...	Regular	...	High

Source: OECD/WB (2003); and data provided by country authorities.

1/ Non-governmental agencies play active role (high), are directly consulted (medium), or are not involved (low).
2/ "Self" refers to analysis of forecasting performance in end-of-year reports; "external" refers to reviews by government audit office or other external agency.
3/ Measures the number of annual and regularly provided central government reports on fiscal forecasting from the list of reporting items based on OECD Best Practices. The scores for high, medium and low refer to the country score relative to the group average (=medium).

against other forecasting agencies (e.g., in Sweden). The main trade-off between the two approaches is that greater involvement of outside agencies may boost forecast credibility, whereas a broader consultation process could imply the use of less systematic forecasting techniques, which may make it more difficult to pinpoint the cause of forecast errors.

22. ***Like the majority of surveyed countries, revenue and expenditure forecasts in Canada are prepared by the Ministry of Finance***. The formalization of the forecasting process varies quite significantly across countries. Some countries prepare stylized forecasts with some cross-checks against sectoral and revenue experts (e.g. Sweden, Switzerland). Others use detailed model driven processes and micro-data based models maintained by technical experts. (e.g., Australia, France, and the United Kingdom). In Canada, there is little direct involvement of outside agencies in preparing revenue and expenditure forecasts for the annual budget. However, projections for the mid-year fiscal update are compiled by a small group of private forecasters, providing an independent view of the medium-term implications of current fiscal policies. Other countries have assigned similar tasks to independent agencies. For example, the U.S. Congressional Budget Office regularly provides 10-year projections of major economic and fiscal variables, based on fiscal policies as legislated by the U.S. Congress. Australia assesses its fiscal forecast through an extensive consultation process with outside experts and the business sector.

23. ***The Canadian public has relatively broad access to budgetary information***. A comparison of the detail of published fiscal information shows that Canada scores high relative to countries in the benchmark group (see Table 6). The primary budget documents available to the public are the annual *Budget Plan* (usually released in February or March) and the *Economic and Fiscal Update* prepared mid-year. Both the Budget Plan and the Update provide economic and fiscal forecasts with detailed explanations of anticipated future developments. The level and detail of published information is comparatively high.

24. ***However, the closed nature of the budget compilation process implies that forecast risks may not be widely understood, limiting public debate on this aspect***. As many other countries, Canada provides relatively little information on the key assumptions and methods underlying the use of macroeconomic assumptions in the compilation of budget forecasts, making it difficult for outsiders to distinguish between fiscal forecasting performance and errors arising from implicit prudence factors.[45] Some countries in the benchmark group are more inclusive in this regard. In Germany, tax revenue forecasts are the result of a consensus of a technical expert group with participation of non-governmental agencies, providing some assurances that fiscal forecasts are untainted by policy objectives.[46] In Australia and New Zealand, governments are legally required to demonstrate, at the time the budget is issued, that budget policies are consistent with long-term fiscal objectives, including by establishing a clear link between policy objectives, forecasts, and outcomes. This requirement has led to a greater emphasis on forecast outcomes, with performance assessments being used to gauge the realism of new budget plans (Box 3).

25. ***Unlike most benchmark countries, the Canadian government provides regular and detailed ex-post analyses of its fiscal forecasting performance***. Only a few countries mandate such reports on an annual basis (e.g., Australia, New Zealand, and the United Kingdom). However, despite the lack of an explicit legal requirement, the Canadian government's *Annual Financial Report* analyzes fiscal results for the previous fiscal year, including by listing the sources of deviations from initial forecasts. The Canadian government also initiated a comprehensive review of its forecasting performance in 1994. A special task force conducted reviews of the accuracy of the Department of Finance's economic and fiscal forecasts and their role in the budget planning process, initiating changes that led to the budget process in its current form. A more focused review and consultations with a group of private sector economists in 1999 led to a more explicit treatment of the prudence factor and the introduction of five-year fiscal forecasts beginning with the *Economic and Fiscal Update* in that year (see Box 2).

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[45] Beginning with the *2004 Economic and Fiscal Update*, the government has committed to provide additional information on how national accounts-based fiscal projections provided by private sector forecasters translates into the accounting framework used in the budget.

[46] The 2004 report by Germany's government auditor (the *Bundesrechnungshof*) remarked that tax forecasts were too optimistic, but largely attributed this outcome to overly positive assumptions about macroeconomic developments which are made by the Ministry of Finance.

Box 3. Forecasting Performance and Budget Debate in New Zealand

Faced with a growing debt burden and a history of poor fiscal performance, New Zealand introduced a formal framework to guide its fiscal planning process in the early 1990s. The 1994 *Fiscal Responsibility Act* requires the government to communicate its policy intentions and to quantify the short- and long-term effects of the associated spending and taxation decisions. In addition to extensive data reporting requirements, the law also mandates a continuing review of policy plans and their financial implications, which are assessed against budget plans and actual developments. This review process is enforced through the publication of two regular reports which have enriched the budget debate by making the inherent risks to the fiscal forecast more accessible to the broader public.

- The *Budget Policy Statement* specifies the fiscal intentions of the government for the next three years, including strategic priorities and targets for spending, revenue, the fiscal surplus, and public debt. The policy goals have to be in line with the responsibility principles set out in the 1994 law.

- The *Fiscal Strategy Report*—published at the time of the budget—focuses on the quantitative implications of policies contained in the *Budget Policy Statement*, and assesses whether the budget is consistent with the longer term policy plans. The report is also required to identify deviations between the projected implications under previous policy plans and their original intentions.

By requiring the government to provide separate statements on overall policy goals and their fiscal implications, the public is in a better position to assess the government's track record in meeting its fiscal goals. Mandatory evaluations of the consistency between long-term goals and short-term plans have put greater emphasis on forecast accuracy, and thus on the forecasting process. With deviations of fiscal outturns from projections subject to greater scrutiny, information about sources of forecast errors is being disclosed, and the government has commissioned regular external and internal reviews of forecasting processes and methods.

D. Assessing Forecast Accuracy

26. ***Data problems generally limit the analysis of fiscal forecasting performance across countries***. Although a number of studies have compared macroeconomic forecast accuracy of private sector economists and international organizations (Artis, 1996; Artis and Marcellino, 2001; Ash, *et al*., 1998; Batchelor, 2001; Isiklar, *et al*., 2004, Loungani, 2000; Öller and Barot, 2000), most analyses of budget projections have focused on a single country, given difficulties in obtaining a cross-country data set of budget forecasts. More recently, two studies have analyzed budgetary forecasts for a group of relatively homogenous countries (euro zone members), with one suggesting that the size of forecast errors may depend on structural characteristics of a country's budgetary framework (Strauch, *et al.*, 2004), and the other calling for independent budget forecasting agencies on the basis of significant forecast biases (Jonung and Larch, 2004).

27. ***Information obtained for this study provided sufficient detail to compare Canadian central government budget forecasts with benchmark countries in recent years***. At a minimum, most budgets provide 3−4 years of information for key macroeconomic and fiscal variables, including actual or estimated values for the preceding year, an estimate or

projection for the current, and projections for one or two future fiscal years.[47] Most budgets are also compiled near the beginning of a new fiscal year, with the result that the values of economic and fiscal variables reported for the prior year are generally at or close to their final revision. This allows the use of historical data reported in the budget as basis for comparison with projections contained in earlier budgets. A description of available data is contained in Appendix I, and methodological issues are covered in Appendix II.

28. ***Budget projections are evaluated against subsequent budget "actuals", which provides two advantages over using fully revised values as reported today***. First, data revisions (caused, e.g., by changes in the coverage of government accounts) may be retroactively applied to fiscal outcomes, but not to past budget projections. Therefore, revised historical data cannot be used to measure the accuracy of projections made before a revision has come into force. Under this paper's definition of forecast errors, data losses are limited to at most 2−3 observations around the time a revision was introduced. Moreover, this method is also "fair" in that it focuses on the information that was available to forecasters at the time and mattered for economic agents' expectation formation.

29. ***On this basis, a comparison of forecasts errors shows notable differences between Canada and other benchmark countries***. For example, projection errors for real GDP growth in Canada appear to have been on the optimistic side in the early 1990s, followed by a more cautious approach during the high-growth phase in the second half of the 1990s (Figure 2).[48] A similar pattern can be observed in the United States, whereas, e.g., German or Swiss budget forecasters appear to have maintained a more optimistic outlook over time. On the other hand, Canadian fiscal forecasts appear to have been consistently one-sided since the mid-1990s, whereas most other countries have reported two-sided errors (Figure 3). Before proceeding to a more formal evaluation, however, a word of caution is on order.

Data Caveats

30. ***Reflecting the idiosyncratic nature of every country's budget process, the empirical analysis remains complicated by data limitations***. The most important constraints, partly obvious from Figures 2 and 3, are the following:

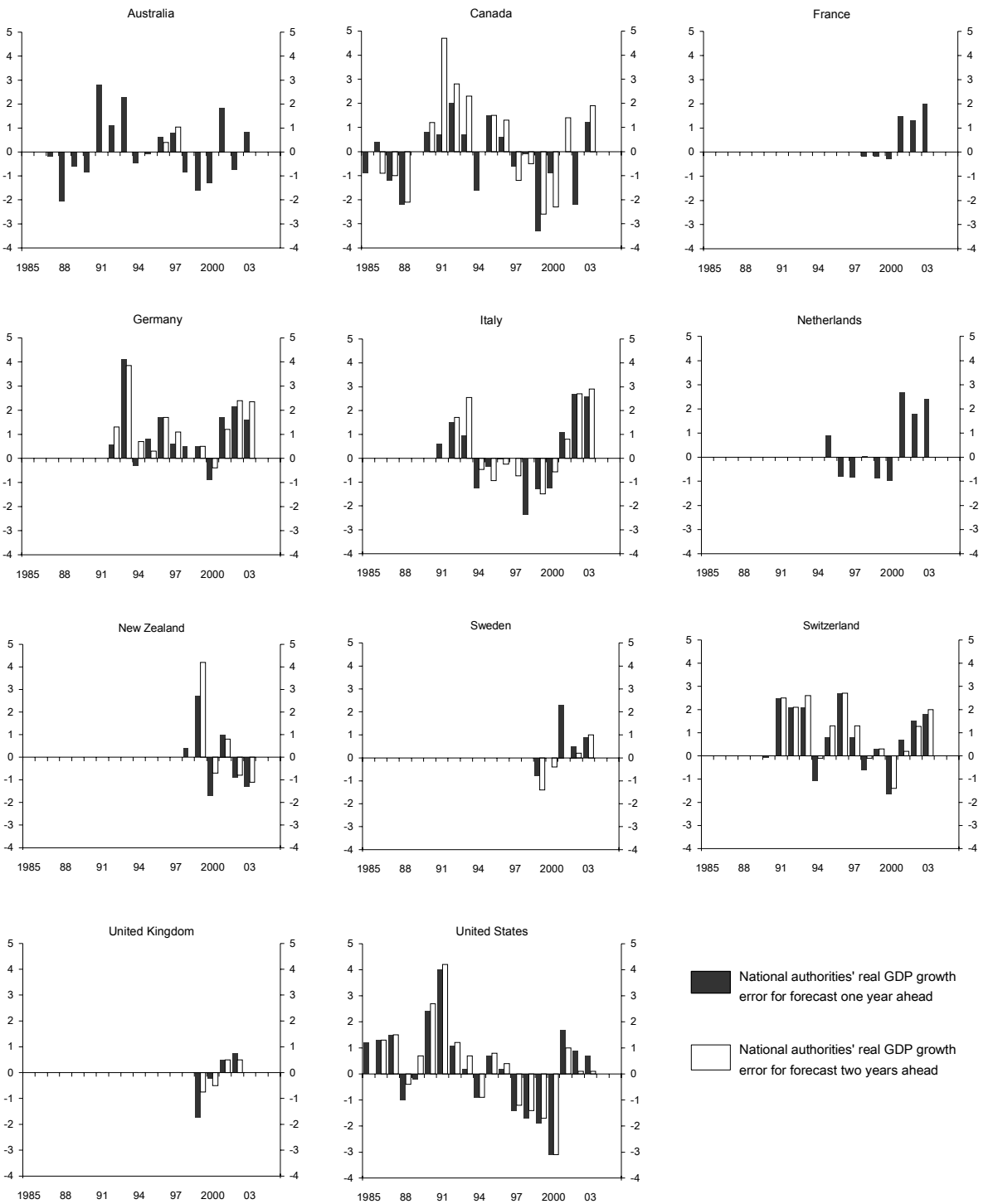
- ***Time series of consistent forecasts and budget outcomes are relatively short (often with less than 10 observations), limiting the power of statistical tests***. Many countries updated their budget formats and forecasting methods in the early to mid-1990s. This has generally increased the level of information provided but also resulted in structural breaks as new budget concepts and coverage were adopted.

[47] Given the small number of countries providing medium-term projections, three and more year-forecasts were not considered for this study. Also, central government forecasts were not available for a number of countries, in which case general government forecasts were used.

[48] Errors are defined as projected minus actual values. A negative value therefore implies that the outcome has exceeded expectations, and vice versa.

Figure 2. Forecast Errors: Real GDP Growth

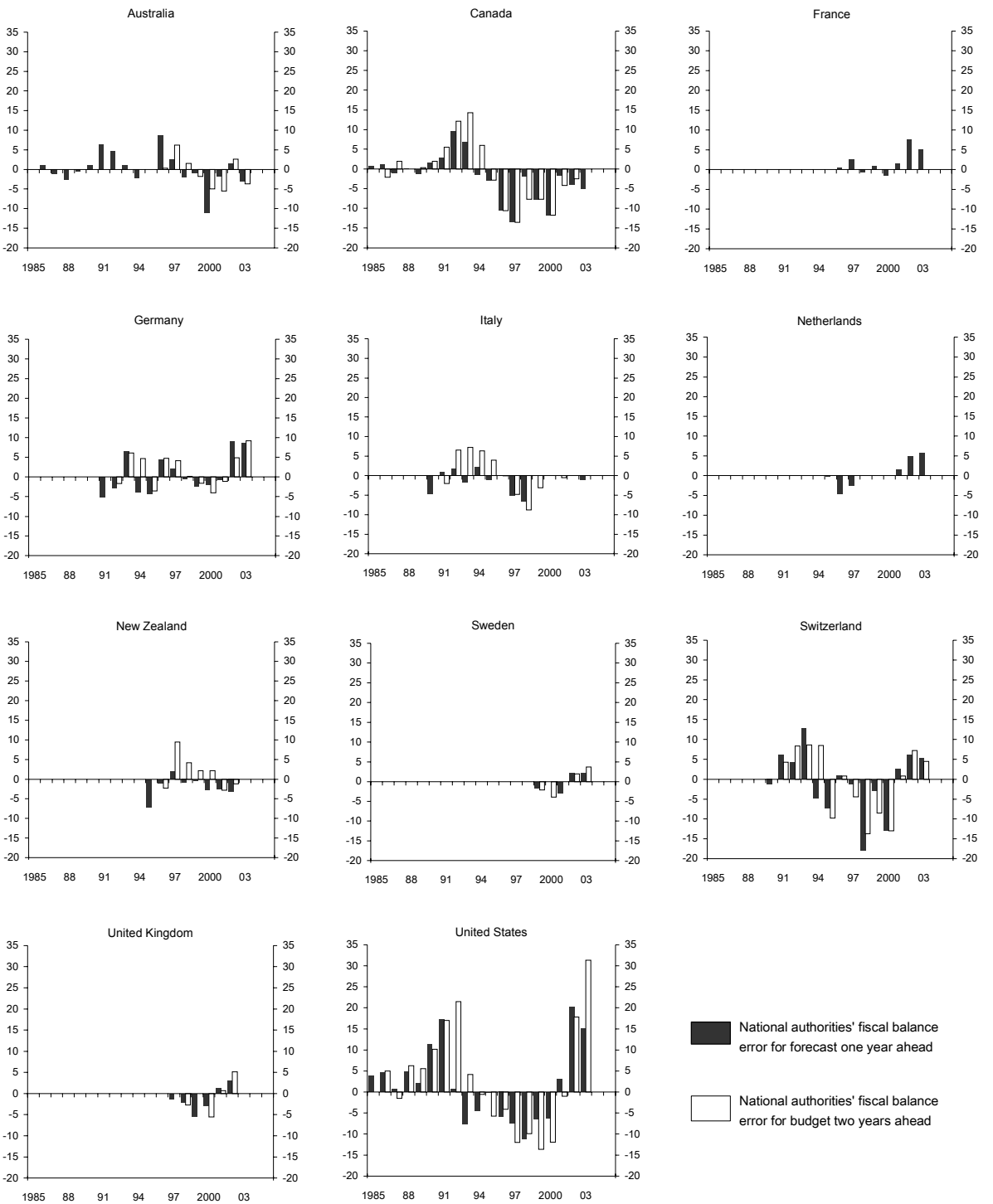
(forecast minus actual growth rate)



Souce: Staff calculations.

Figure 3. Forecast Errors: Fiscal Balance

(forecast error in percent of size of government)



Souce: Staff calculations.

- ***Although the coverage of revenue and expenditure data is broadly similar across most countries, there are limits to how closely they can be compared***. For example, while tax categories are relatively similar, some countries include social insurance contributions as government revenues. Moreover, sources for nontax revenues (which may include receipts from asset sales, royalties from natural resources, or frequency spectrum fees, to name a few) tend to differ significantly across countries.

- ***A comparison of expenditure subcategories appears particularly difficult***. For example, the distinction between discretionary and mandatory spending components—each of which poses a different challenge to budget forecasters—is difficult to obtain for most countries, or can only be approximated. Similarly, data on transfers to other levels of government are not provided on a consistent basis.

- ***Checks for internal consistency and structural breaks may not have captured all data anomalies***. These checks resulted in the rejection of a considerable number of data points. However, given relatively scant institutional knowledge of the information contained in government budgets more than a few years back, only obvious statistical outliers were eliminated.

31. ***Importantly, revised forecasts published in mid-year budget updates or other publications are also not considered in this study***. In many countries, governments provide updated budget projections in the course of the fiscal year—for example, in Canada's Economic and Fiscal Update, or in convergence programs provided by countries in the euro area. Other public bodies (such as the U.S. Congressional Budget Office) often conduct complementary analyses of fiscal developments. Including such information, however, would have greatly increased the cost of collecting and preparing a consistent data set.

32. ***This may exacerbate problems caused by policy shifts that are implemented mid-year***. For example, the relatively large U.S. fiscal "error" underlines the difficulties in limiting the focus of this study to annual budget documents. If negotiations over fiscal measures conclude a considerable time after a budget has been published, the likelihood that policy outcomes differ from underlying assumptions in the budget may be higher, possibly resulting in a significant deviation of fiscal projections from outcomes. However, such deviations would be policy-driven and not the responsibility of budget forecasters.[49]

Macroeconomic forecasts

33. ***The remainder of this section presents a formal comparison of forecast errors since 1995, separated into macroeconomic and fiscal projections***. First, the mean error (ME) and root mean squared error (RMSE) for one-year forecasts of key macroeconomic variables are presented in Table 7. The mean error is the simple average of forecast errors over 1995−2003, providing an indication of the direction of forecast errors. The RMSE, defined as the square root of the mean of the errors squared, is independent of the error sign and

[49] Indeed, the consequences of U.S. tax and spending measures were well anticipated at the time of passage.

Table 7. Descriptive Statistics of One-Year Budget Forecast Errors, 1995-2003[1]

	Australia	Canada	France	Germany	Italy	Nether-lands	New Zealand	Sweden	Switzer-land	U.K.	U.S.
Macroeconomic Variables											
Nominal GDP	-0.0066	-0.0236	0.0035	0.0244	0.0002	-0.0111	-0.0037	-0.0271	0.0116	-0.0170	-0.0168
	0.0290	0.0344	0.0142	0.0292	0.0138	0.0296	0.0209	0.0357	0.0281	0.0199	0.0390
	8	9	8	9	9	9	9	4	9	6	9
Real GDP growth	-0.0500	-0.4750	0.6833	0.9611	0.1395	0.4778	0.0333	0.7250	0.7078	-0.1500	-0.4333
	1.1592	1.7211	1.2364	1.3393	1.8577	1.5830	1.6637	1.4679	1.4698	0.9893	1.6809
	9	8	6	9	8	9	6	4	9	5	9
GDP deflator	0.2859	-0.1750	0.1833	0.5611	…	-0.1611	…	0.2557	0.5762	0.0057	0.1669
	1.2536	1.0522	0.3623	0.7792	…	0.6889	…	1.2417	0.9609	0.9038	0.3510
	9	8	6	9	0	9	0	4	9	5	9
Unemployment rate	0.4000	0.0875	…	…	0.2333	0.3500	0.2000	-0.3500	…	…	0.2778
	0.6638	0.2834	…	…	0.4447	0.6005	0.5797	0.6265	…	…	0.8149
	9	8	0	0	3	9	6	4	0	0	9
Fiscal Variables											
Government revenue	-0.0154	-0.0379	0.0105	0.0155	-0.0180	-0.0278	-0.0175	-0.0329	-0.0209	-0.0085	0.0027
	0.0466	0.0620	0.0313	0.0464	0.0280	0.1232	0.0288	0.0351	0.0840	0.0276	0.0921
	8	9	6	9	6	6	8	4	9	6	9
Tax revenue	-0.0207	-0.0292	0.0086	0.0226	…	0.0024	0.0001	-0.0409	…	-0.0055	0.0049
	0.0510	0.0569	0.0286	0.0507	…	0.0542	0.0244	0.0430	…	0.0262	0.0993
	8	9	6	9	0	9	9	4	0	6	9
Personal income tax	0.0093	-0.0273	…	0.0605	…	0.0199	-0.0063	-0.0257	…	-0.0194	-0.0145
	0.0234	0.0537	…	0.1032	…	0.0713	0.0215	0.0360	…	0.0435	0.1524
	2	9	0	9	0	6	9	4	0	6	9
Corporate income tax	-0.0686	-0.0694	…	0.1352	…	0.0388	0.0371	-0.0387	…	0.0065	0.0987
	0.1068	0.1652	…	0.4788	…	0.1803	0.1035	0.2194	…	0.1093	0.2340
	2	9	0	9	0	6	9	4	0	6	9
Social insurance taxes	-0.0885	…	…	…	…	…	…	…	…	-0.0168	-0.0004
	0.1486	…	…	…	…	…	…	…	…	0.0234	0.0277
	2	0	0	0	0	0	0	0	0	6	9
Indirect taxes	-0.0276	-0.0160	…	0.0349	…	0.0087	0.0015	-0.1304	…	-0.0017	0.0772
	0.0407	0.0603	…	0.0926	…	0.0357	0.0455	0.2043	…	0.0078	0.1039
	2	9	0	9	0	6	9	4	0	6	9
Other revenue	-0.0434	-0.1861	…	-0.0550	…	-0.3883	-0.2091	0.0343	…	-0.0649	0.0642
	0.1244	0.2350	…	0.1589	…	0.5502	0.2592	0.0730	…	0.1695	0.2241
	8	9	0	9	0	5	8	4	0	6	9
Government expenditure	-0.0062	0.0082	-0.0111	-0.0007	0.0076	-0.0172	0.0022	0.0082	0.0110	0.0072	0.0027
	0.0288	0.0258	0.0178	0.0234	0.0261	0.0678	0.0092	0.0146	0.0222	0.0100	0.0209
	8	9	6	9	6	6	8	7	9	6	9
Mandatory expenditure	…	-0.0020	…	-0.0225	…	…	…	…	…	…	0.0159
	…	0.0435	…	0.0394	…	…	…	…	…	…	0.0314
	0	9	0	9	0	0	0	0	0	0	9
Discretionary expenditure	…	-0.0051	…	0.0568	…	…	…	…	…	…	-0.0221
	…	0.0362	…	0.0715	…	…	…	…	…	…	0.0340
	0	9	0	9	0	0	0	0	0	0	9
Interest expenditure	-0.0750	0.0245	…	0.0187	0.0079	-0.0131	-0.0200	0.0364	…	0.0093	0.0295
	0.1040	0.0458	…	0.1381	0.0566	0.1260	0.0501	0.1503	…	…	0.0816
	9	7	0	9	6	9	9	4	0	1	9
Fiscal balance	-0.8025	-6.5427	1.9792	1.5599	-2.4218	0.7900	-1.9792	-0.0811	-3.0378	-1.2985	0.0711
	5.6913	7.9428	3.6246	5.0669	3.7109	4.2089	3.2954	2.5785	8.7606	3.2585	10.8211
	8	9	8	9	6	6	8	4	9	6	9
GDP ratios											
Government revenue	-0.1375	-0.2723	0.1727	-0.0934	-0.3433	-1.5255	-0.5984	-0.3000	-0.3643	0.3264	0.4333
	0.6645	0.7071	0.4355	0.4248	0.6721	3.3993	1.0994	1.4663	0.8941	0.8507	1.4397
	8	9	6	9	6	5	8	4	9	6	9
Government expenditure	-0.0875	0.5204	-0.1671	-0.2888	0.4600	-1.0793	0.0848	0.2883	-0.0076	0.9485	0.3000
	1.0256	0.7185	0.3747	0.5317	1.3600	1.9885	0.6233	0.5278	0.4187	1.0896	1.0654
	8	9	6	9	6	5	8	7	9	6	9
Fiscal balance	-0.1111	-1.1146	0.3625	0.1954	-0.7867	-0.3106	0.1331	-0.0250	-0.3567	-0.5122	-0.0778
	1.3950	1.3637	0.6626	0.5926	1.2274	1.9998	0.4821	1.2013	1.0577	1.2705	2.0367
	9	9	8	9	6	5	8	4	9	6	9

Source: Staff calculations.

[1] For each variable, rows list mean error, root mean square error, and number of observations. Errors are calculated in percent of actual outcomes, except for forecasts of GDP growth, GDP inflation, the unemployment rate, and GDP ratios where simple difference was taken. Error in forecasting fiscal balance expressed in percent of average of actual revenue and expenditure. Positive error indicates that forecast was above outturn.

therefore a better measure for the size of forecast errors. Limiting the sample to the years indicated focuses the analysis on the period during which the current Canadian forecasting methodology was in force. Moreover, longer time series were not available for many countries, and 2005 budgets have not yet been released in most cases.

34. ***The evidence suggests that economic growth in Canada has on average been ½ percentage point higher than budget projections in recent years***. Canadian projections of nominal GDP and real GDP growth show higher RMSEs than in most other countries, and Canadian mean errors are at the negative end among the benchmark countries (Figure 4). Decomposing the RMSE into its two components indicates that this result appears to be mostly a function of the large mean error, given that the standard deviation of Canadian forecast errors has not been as high as in many other benchmark countries.[50] This could suggest that Canadian forecasters have adopted a relatively consistent forecast bias, as opposed to other countries where deviations are spread more equally on the positive and the negative side (see next section for statistical tests of this hypothesis).

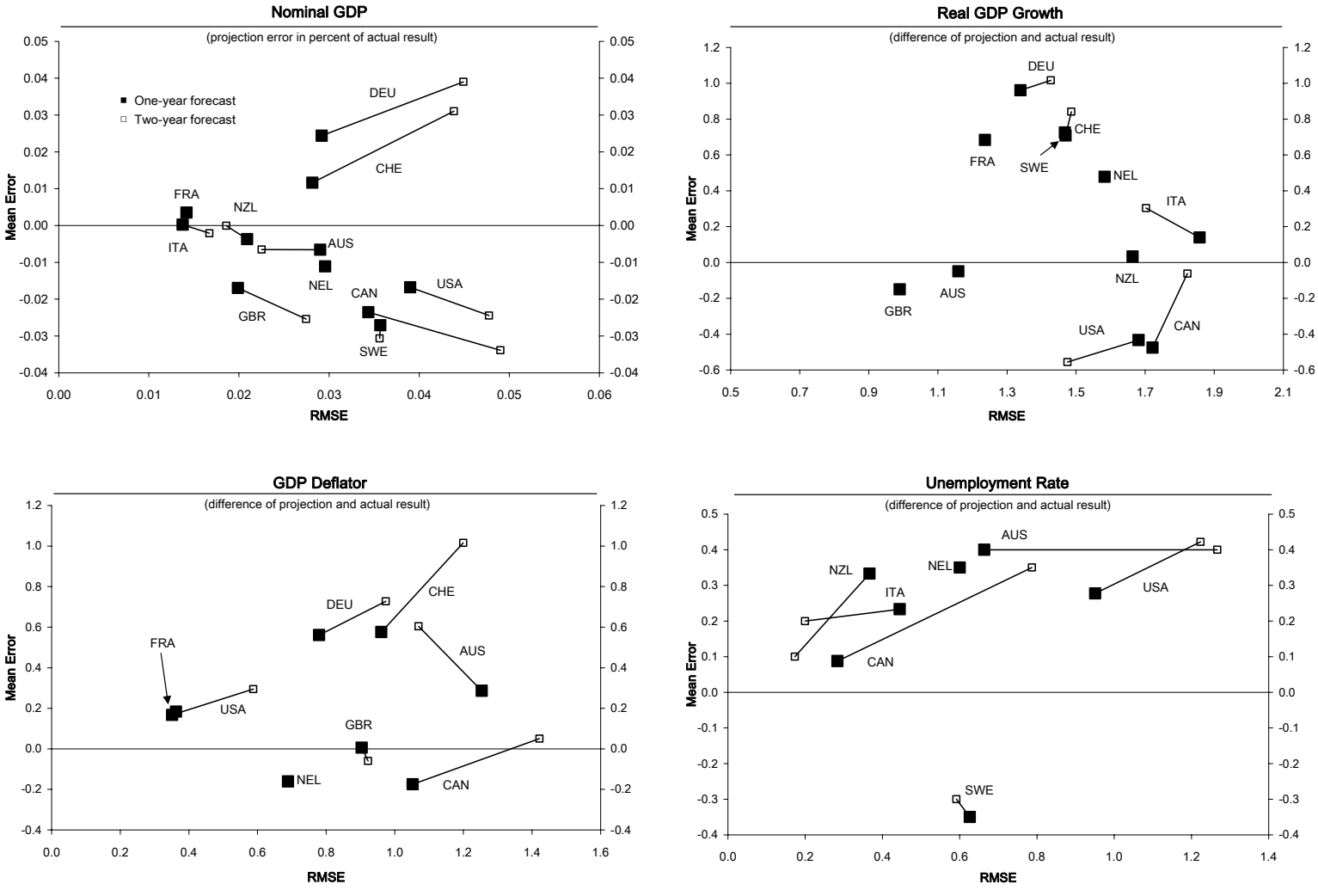
35. ***Canadian forecasters also underestimated GDP inflation by 0.2 percentage points on average, but short-term unemployment trends were anticipated quite well***. Projection errors for increases in the GDP deflator show a distribution similar to the growth forecast, with high RMSEs and a mean at the negative end among the sample countries. By contrast, the one-year forecast of the unemployment rate exhibited a lower RMSE and (positive) mean error than for other countries.

36. ***These findings indicate that Canadian budget forecasts generally adopted a conservative view of macroeconomic developments over the past 10 years***. Errors made in forecasting major macroeconomic variables are internally consistent. Growth and inflation were on average stronger than expected, and unemployment rates lower than anticipated. The projection of nominal GDP also suffers from the fact that Canadian forecasters have underestimated base year GDP by about one percent on average—the largest negative value in the benchmark group (see Appendix II, equation 4, for a breakdown of the nominal GDP forecast error into the errors for base year GDP, real growth and GDP inflation).[51] Macroeconomic prudence adjustment through the 1998 budget—affecting about half of all sample years for Canada—is estimated to account for 0.1 percentage points of the mean real growth forecast error, and for half as much of the mean GDP inflation error.

[50] See Appendix II, equation 6.

[51] For this study, the base year (or "in-year") is the year preceding the budget year (for example, the base year for the FY 2004-05 budget is FY 2003-04). Although a similarly large base year error was only found for the United States, cross-country comparisons involving the GDP deflator suffer from the fact that inflation forecasts were not available for some countries, and had to be calculated as the difference between the nominal and real GDP growth rates, with base year values substituting for actual values.

Figure 4. Descriptive Statistics for One- and Two-Year Macroeconomic Budget Forecasts, 1995-2003



Source: Staff calculations.

Fiscal forecasts

37. ***A similarly conservative approach appears to have been applied to Canada's fiscal projections***. An analysis of revenue and expenditure projections generally finds Canada among the group of countries with relatively weak forecast accuracy (as measured by the RMSE). Moreover, compared to the benchmark group, the average error takes on one of the largest negative values for revenues, and one of the largest positive values for expenditures (Figure 5). Taken together, this implies that Canada has the largest negative mean error for the overall deficit forecast, even after allowing for economic prudence and contingency factors.[52]

38. **On the revenue side, projections of personal income tax and GST/MST revenue have contributed most to the overall forecast error** (Figure 6). As far as subcomponents of tax revenue are concerned, Canadian RMSEs are generally not as large relative to other countries as for aggregate revenues. What makes Canada stand out, however, is that the mean error for all subcomponents is negative, compared to at least one positive error for all of the other 5 countries for which similar data have been available. It is the accumulation of small but persistently negative errors, rather than large forecast errors *per se*, that make Canadian forecasters appear relatively pessimistic.

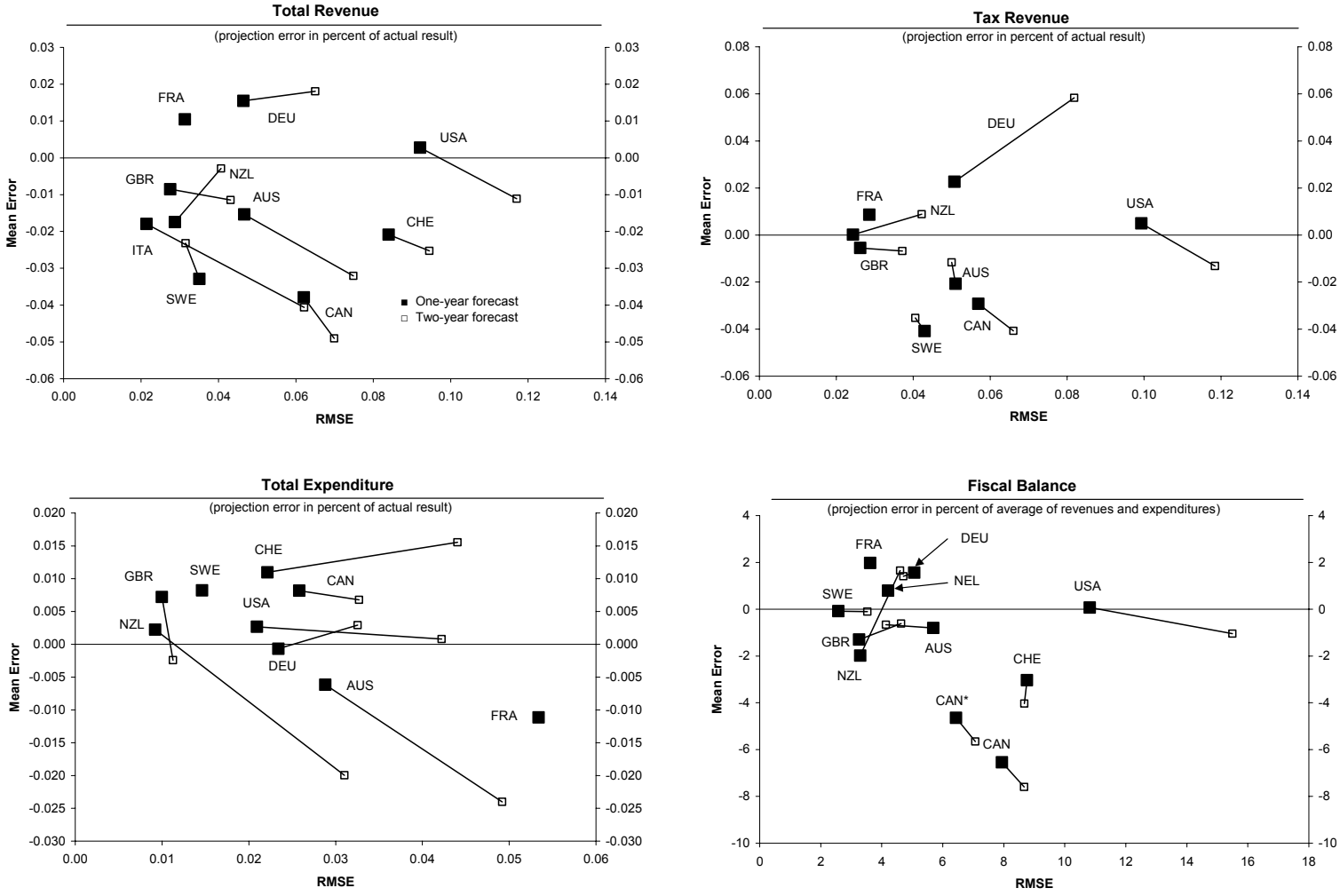
39. ***Deviations on the expenditure side appear partly driven by smaller than expected debt servicing costs***. For all countries, expenditure forecasts have been significantly more accurate than revenue forecasts, as evident from substantially lower MEs and RMSEs. Canada has been no exception as far as mandatory and discretionary expenditure items are concerned. However, interest payments were on average 2 percent lower than projected, leading to an average forecast error of 0.1 percent of GDP.[53]

40. ***Even when scaled by the size of GDP, Canadian fiscal forecasts appear unusually conservative***. When forecast errors are defined as the difference between actual and projected GDP ratios, Canada still has the largest negative mean error compared to the benchmark group (see Figure 6, bottom right panel), although the RMSEs are in a more moderate range. Canada may have been helped by the fact that forecast accuracy improves once revenues are expressed as GDP ratios, given the close to unit elasticity of tax revenues in many countries. On the other hand, projections of expenditure-to-GDP ratios suffer particularly from GDP forecast errors as nominal expenditures tend to be more closely in line with budget targets.

[52] Economic prudence and contingency are categorized neither as revenue nor expenditure, with the result that the discrepancy between projected and actual deficits in Canada is larger than the difference between the revenue and expenditure errors. Redefining the projected deficit as the difference between revenue and expenditure projections corrects for this factor.

[53] The forecast error for debt service charges also stems partly from a prudence adjustment to the interest rate forecast in the late 1990s, although this effect could not be quantified.

Figure 5. Descriptive Statistics for One- and Two-Year Fiscal Budget Forecasts, 1995-2003

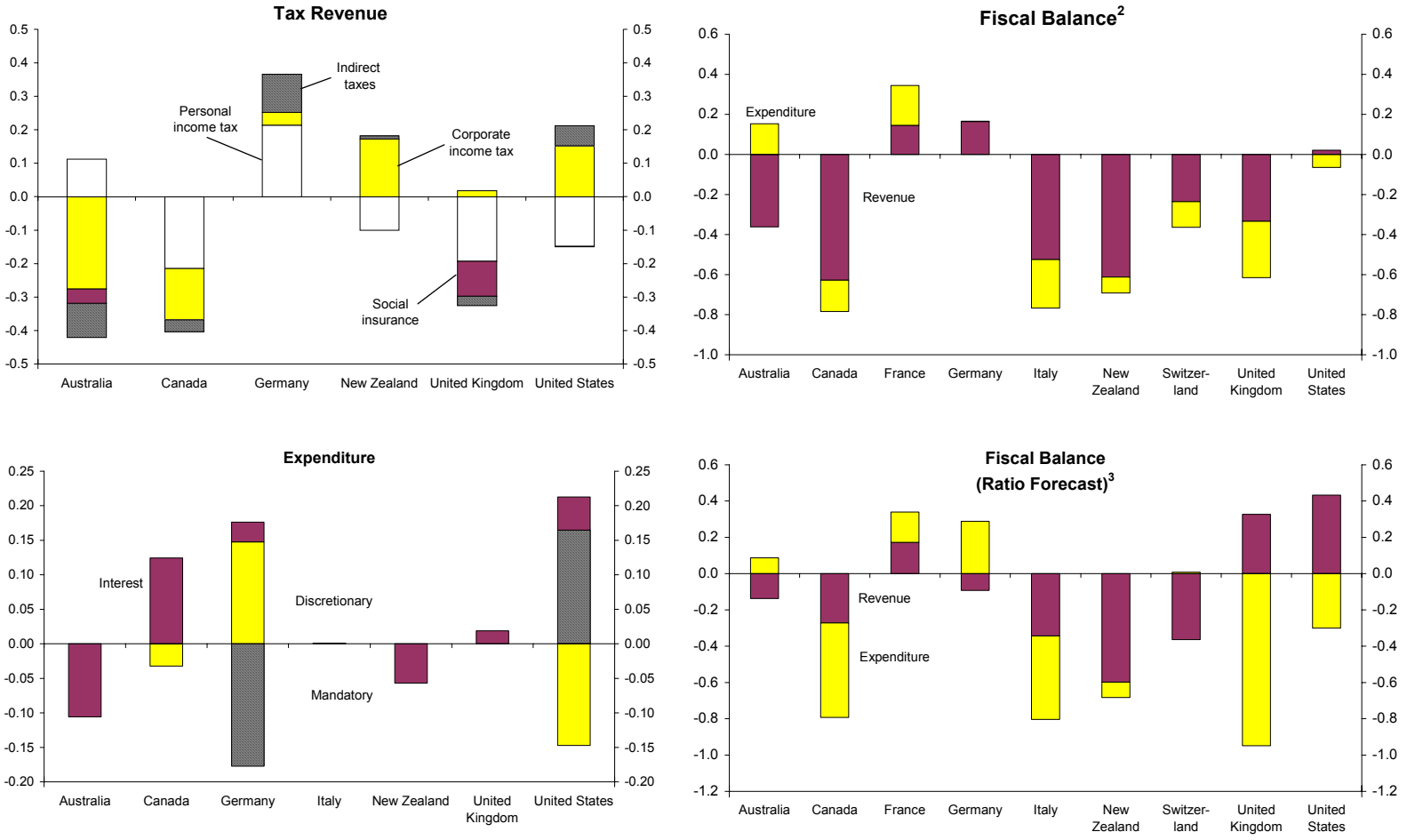


Source: Staff calculations.

[1] CAN* indicates forecast error relative to planning target (i.e., excluding prudence and contingency).

Figure 6. Decomposition of Mean Forecast Errors[1]

(Forecast errors in percent of GDP)



Source: Staff calculations.

[1] Components may not add up to overall amounts as only most common components are listed or information is incomplete.

[2] Forecast erro in nominal terms in percent of actual GDP.

[3] Difference in projected and actual revenue and expenditure-to-GDP ratios.

E. Statistical Analysis of Forecast Outcomes

41. ***This section uses statistical tests to further explore the forecast characteristics described in the previous section***. First, tests will be used to check for the presence of a forecast bias, and whether projections are efficient in the sense that they use all information available at the time of the forecast. Second, budget projections for GDP growth and the fiscal balance are compared with private sector consensus forecasts. Third, using structural information described earlier in this paper, country data are pooled to test whether variables describing the forecasting environment have a significant impact on projection outcomes.

Bias and efficiency tests

42. ***A series of statistical tests confirm a forecasting bias in some components of Canada's macroeconomic and fiscal forecasts*** (Table 8). The tests—which are described in Appendix II—suggest that, between 1995 and 2003, the mean and median of the forecasts for nominal GDP, as well as total and nontax government revenue were significantly different from zero. This places Canada in a group with Germany, New Zealand, Sweden, and the United Kingdom, which all exhibit a consistent bias in either the macro forecast or aggregate fiscal revenues or expenditures. By comparison, Australia, France, Italy, the Netherlands, and the United States are largely free of such findings.

43. ***The tests also underline that it is the aggregation of small unidirectional forecast errors that leads to an overall bias in growth and revenue estimates in Canada***. For example, both real GDP growth and GDP inflation forecasts have a negative mean error that is not statistically different from zero. However, the hypothesis of a zero nominal GDP error (to which both the growth and inflation error contribute) is clearly rejected. Similarly, the mean errors of individual tax revenue components were not significant at the 10 percent level, unlike the statistically significant aggregate revenue forecast error. Nontax revenues, which account for about 10 percent of total revenues, also appear strongly downward biased.

44. ***Errors in the output projection tend to explain a substantial share of revenue errors across most countries, including in Canada***. In a second battery of mean tests, forecast errors for macroeconomic variables were added to the right hand side of the test regression. Whereas inflation and unemployment rate forecast errors failed to affect test outcomes, either nominal GDP or real growth errors eliminated much of the apparent bias in revenue forecasts across most countries. In the case of Canada, the null hypothesis of unbiased forecasts was no longer rejected once nominal GDP errors were included, suggesting a close approximation of the country's tax base.[54] Given the typically small share of unemployment assistance and other cyclically sensitive components in total government expenditure, it is not surprising that macroeconomic variables appear to have a lesser influence on the outcome of

[54] Among countries with a significant nominal GDP coefficient, the measured elasticity of revenue errors was between 1¼ and 2, with Canada in the middle (1½) and the United States at the high end.

Table 8. Results of Forecast Error Median and Mean Tests[1]

	Australia	Canada	France	Germany	Italy	Nether-lands	New Zea-land 2/	Sweden 2/	Switzer-land	U.K.	U.S.
Nominal GDP	- (8)	SWVCc (9)	- (8)	SWVCc (9)	- (9)	- (9)	- (9)	C (4)	- (9)	SWVC (6)	- (9)
Real GDP growth	- (9)	- (8)	- (6)	SWVCc (9)	- (8)	- (9)	- (6)	- (4)	- (9)	- (5)	- (9)
GDP inflation 3/	- (9)	- (8)	- (6)	Cc (9)	…	- (9)	…	- (4)	Cc (9)	- (5)	c (9)
Unemployment rate 3/	C (9)	- (8)	…	…	- (3)	C (9)	- (6)	- (4)	…	…	- (9)
Government revenue	- (8)	WVCc (9)	- (6)	- (9)	Cc (6)	- (6)	WVC (8)	VC (4)	- (9)	- (6)	- (9)
Tax revenue	- (8)	- (9)	- (6)	- (9)	…	- (9)	- (9)	VC (4)	…	- (6)	- (9)
of which:											
Personal income tax 3/	- (2)	- (9)	…	C (9)	…	- (6)	- (9)	C (4)	…	- (6)	- (9)
Corporate income tax 3/	- (2)	- (9)	…	- (9)	…	- (6)	- (9)	- (4)	…	- (6)	- (9)
Social insurance taxes 3/	- (2)	…	…	…	…	…	…	…	…	C (6)	- (9)
Indirect taxes 3/	- (2)	- (9)	…	- (9)	…	- (6)	- (9)	- (4)	…	- (6)	C (9)
Other revenue	- (8)	SWVCc (9)	…	- (9)	…	SWVCc (5)	SWVCc (8)	- (4)	…	- (6)	- (9)
Government expenditure	- (8)	- (9)	Cc (6)	- (9)	- (6)	- (6)	- (8)	SWVc (7)	SW (9)	WVC (6)	- (9)
Mandatory expenditure	…	- (9)	…	C (9)	…	…	…	…	…	…	WV (9)
Discretionary expenditure	…	- (9)	…	SWVCc (9)	…	…	…	…	…	…	SWVC (9)
Interest expenditure	SWVCc (9)	- (7)	…	S (9)	- (6)	- (9)	c (9)	- (4)	…	- (0)	- (9)
Fiscal balance 3/	- (8)	C (9)	- (8)	- (9)	C (6)	- (6)	C (8)	- (4)	- (9)	- (6)	- (9)
Mean tests including growth terms 4/											
Government revenue	- (8)	Gg (9)	ng (6)	g (9)	Nng (6)	nGg (6)	NG (8)	NG (4)	Gg (9)	n (6)	- (9)
Tax revenue	- (8)	g (9)	ng (6)	- (9)	…	g (9)	- (9)	NG (4)	…	- (6)	- (9)
Other revenue	n (7)	Gg (9)	…	- (9)	…	NnGg (5)	NnGg (8)	- (4)	…	- (6)	- (9)
Government expenditure	- (8)	g (9)	Nng (6)	- (9)	- (6)	- (6)	- (8)	N (4)	- (9)	g (6)	- (9)
Mandatory expenditure	…	- (9)	…	- (9)	…	…	…	…	…	…	- (9)
Discretionary expenditure	…	- (9)	…	g (9)	…	…	…	…	…	…	NG (9)
Interest expenditure	NnGg (8)	Nn (7)	…	- (9)	g (6)	- (9)	n (9)	- (4)	…	…	- (9)

Source: Staff calculations. See Appendix II for a description of the underlying methods.

1/ Letters indicate tests that reject a zero median or mean at the 10 percent significance level. (1) Median tests. S: sign test, W: Wilcoxon test, V: van der Maerden test; (2) Mean tests. C: regression on constant, c: C with AR(1) term. The number of observations is listed in brackets for each cell.
2/ Test with AR(1) terms and robust residuals were only calculated for variables with more than 4 observations.
3/ Mean test only.
4/ Letters indicate tests that reject zero mean at the 10 percent significance level. N: regression on constant and nominal GDP forecast error, n: N with AR(1) term, G: regression on constant and real GDP growth forecast error, g: G with AR(1) term.

expenditure projections, with exceptions including Sweden and Switzerland and some spending components in the United States and Germany.

45. ***Finally, tests of forecast efficiency suggest that Canadian budget forecasts may not have employed all of the information available at the time they were made***. Under an "efficient" forecasting process, forecasters would update their forecasting models to take into account any source of systematic forecast errors, such as a permanent improvement of a country's growth prospects. As a result, forecast errors would at least be independently if not normally distributed. Using tests described in Appendix II, this hypothesis is rejected for Canadian growth and revenue estimates, as well as a number of variables for Germany, the Netherlands, the United Kingdom, and the United States (Table 9). Consistent with the results of this test, Canada is also one of the few countries to exhibit strong autocorrelation in both tax and nontax revenue errors.

Budget vs. private sector forecasts

46. ***One measure of comparing budget forecasts against each other is to study how they hold up against private sector forecasts in their countries***. For that purpose, one-year budget forecasts were compared with Consensus projections for growth and the fiscal balance, taken from the month when the corresponding budget was released (March for Canada, February for the United States, etc.). Descriptive statistics for consensus projection errors reveal that their magnitude is generally close to those of budget forecast errors, and that neither growth nor fiscal forecast errors are consistently larger for public or private forecasters across countries (Figure 7).

47. ***Differences in government and private sector forecast errors in Canada are relatively small***. Private sector forecasts exhibit a slightly smaller RMSE for growth and fiscal forecasts than those of the government, similar to the cases of Italy and New Zealand (Table 10). Although the difference in the growth forecast appears rather minor—reflecting the fact that budget forecasts are largely based on macroeconomic projections provided by private forecasters—the test of RMSE equality is rejected at relatively high confidence levels. As for the fiscal forecast, anecdotal evidence suggests that the private sector is usually focusing on the underlying budgetary balance (i.e., the simple difference between federal revenues and expenditures, excluding the economic prudence and contingency reserve; Figure 8). The difference in RMSEs indeed becomes statistically insignificant once that concept is used.

48. ***Tests for statistical dominance have also proved inconclusive***. While a visual inspection already suggests that the difference between the two sets of projections is small relative to the magnitude of the overall error, a formal test can also be used to analyze whether one of the forecasts statistically encompasses the other (see Appendix II). As shown in Table 10, these tests often yield inconclusive results—such as when coefficients are estimated with similar magnitude but opposite sign—as in the case of the Canadian growth forecast. The fiscal forecast contained in Canada's budgets appears somewhat weak relative to consensus, but the only clear-cut cases of statistical dominance relate to fiscal forecasts in Italy and New Zealand, where the private sector appears to have a clear edge over the government, and vice versa in France.

Table 9. Results of Efficiency Tests

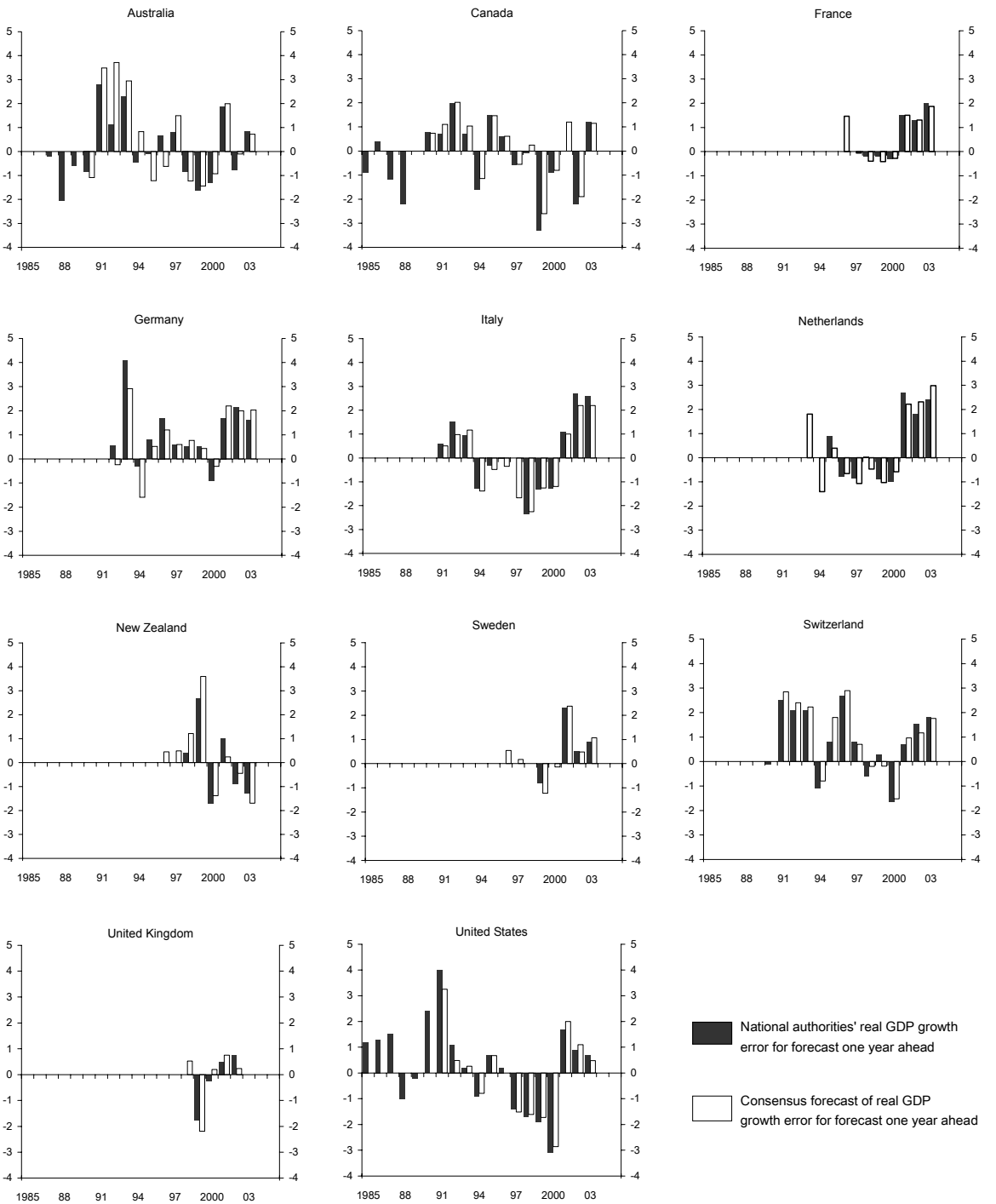
	Australia	Canada	France	Germany	Italy	Nether-lands	New Zea-land	Sweden	Switzer-land	U.K.	U.S.
Joint significance tests[1]											
Nominal GDP	- (8)	FC (9)	- (8)	FC (9)	C (9)	C (9)	- (9)	- (4)	- (9)	FC (6)	- (9)
Real GDP growth	- (9)	C (8)	- (6)	FC (9)	FC (8)	- (9)	- (6)	- (4)	- (9)	C (5)	FC (9)
GDP inflation 3/	- (9)	- (8)	FC (6)	FC (9)	…	- (9)	…	- (4)	FC (9)	- (5)	- (9)
Unemployment rate 3/	FC (9)	- (8)	…	…	C (3)	FC (9)	- (6)	- (4)	…	…	- (9)
Government revenue	- (8)	C (9)	- (6)	- (9)	C (6)	FC (6)	- (8)	FC (4)	- (9)	C (6)	C (9)
Tax revenue	- (8)	- (9)	C (6)	- (9)	…	- (9)	- (9)	FC (4)	…	- (6)	C (9)
of which:											
Personal income tax 3/	…	- (9)	…	FC (9)	…	- (6)	- (9)	FC (4)	…	C (6)	- (9)
Corporate income tax 3/	…	C (9)	…	- (9)	…	FC (6)	- (9)	- (4)	…	C (6)	FC (9)
Social insurance taxes 3/	…	…	…	…	…	…	…	…	…	FC (6)	- (9)
Indirect taxes 3/	…	- (9)	…	- (9)	…	FC (6)	- (9)	- (4)	…	- (6)	FC (9)
Other revenue	- (8)	FC (9)	…	FC (9)	…	FC (5)	FC (8)	- (4)	…	FC (6)	FC (9)
Government expenditure	- (8)	- (9)	- (6)	- (9)	- (6)	- (6)	- (8)	- (7)	- (9)	FC (6)	C (9)
Mandatory expenditure	…	- (9)	…	- (9)	…	…	…	…	…	…	FC (9)
Discretionary expenditure	…	- (9)	…	FC (9)	…	…	…	…	…	…	FC (9)
Interest expenditure	FC (9)	- (7)	…	- (9)	- (6)	FC (9)	- (9)	C (4)	…	…	- (9)
Error autocorrelation[2]											
Nominal GDP	-	-	-	-	-	3	-	-	-	-	-
Real GDP growth	-	-	-	-	1	-	…	-	-	-	-
Government revenue	1	3	-	-	-	-	-	-	-	-	2
Tax revenue	-	2	3	-	…	-	-	-	…	-	3
Other revenue	-	3	…	1	…	-	-	-	…	-	-
Government expenditure	-	-	-	-	2	-	-	-	-	-	-

Source: Staff calculations. See Appendix II for a description of the underlying methods.

1/ Letters indicate which tests reject the joint hypothesis of zero constant and unity coefficient in a regression of actual values on a constant and one-year forecasts at the 10 percent significance level. F: F-Test assuming i.i.d. normal residuals. C: Chi-Square test. The number of observations is listed in brackets for each cell.
2/ Test reports longest lag for which autocorrelation in error terms was found (with a maximum of 3). This test was run with data going back to 1990.

Figure 7. Budget and Consensus One-Year Growth Forecast Errors

(forecast minus actual growth rate)



Souce: Staff calculations.

Table 10. Comparing Budget and Consensus Forecasts

	Australia	Canada[1]		France	Germany	Italy	Nether-lands	New Zea-land	Sweden	Switzer-land	U.K.	U.S.
Consensus Forecast												
Real GDP Growth												
Mean Error	-0.1468	-0.2971		0.5970	1.0501	-0.0181	0.4587	-0.6335	0.6767	0.8203	-0.0938	-0.3843
RSME	1.2776	1.4690		1.2223	1.3611	1.6526	1.6704	1.1669	1.6395	1.5510	1.1948	1.6510
Number of observations	9	8		6	9	8	9	3	4	9	5	9
Fiscal Balance												
Mean Error	4.2995	-4.1836		2.9321	-7.2919	-0.4437	…	-0.1229	…	…	-1.5113	0.1102
RSME	7.0366	5.9744		6.1863	9.3923	2.1655	…	1.5276	…	…	3.7213	11.6112
Number of observations	8	9		8	9	6	…	8	…	…	6	9
Test for RMSE Equality[2]												
Growth Forecast												
F-test (prob)	0.7635	0.0112		0.2876	0.6720	0.0007	0.7977	0.2895	0.2365	0.7682	0.2844	0.6735
Chi square-test (prob)	0.7554	0.0000		0.1774	0.6564	0.0000	0.7918	0.1796	0.0396	0.7604	0.1397	0.6581
Fiscal Balance Forecast												
F-test (prob)	0.0701	0.0198	0.6761	…	0.0036	0.1168	…	0.2626	…	…	0.5966	0.0709
Chi square-test (prob)	0.0139	0.0007	0.6609	…	0.0000	0.0212	…	0.1855	…	…	0.5547	0.0191
Encompassing Test[3]												
Growth Forecast												
Budget (β_0)	-0.3349	-4.1244		4.7033	0.2791	-5.9446	1.2641	-0.6091	3.9354	0.5234	-0.1455	-0.0028
(t-statistic)	-0.77	-4.49		1.05	0.25	-4.45	0.92	-0.66	4.20	0.32	-0.14	0.00
Consensus (β_1)	-1.6358	4.7403		-3.0184	1.0733	5.9657	-0.2955	-4.7099	-4.3690	0.2757	0.0445	-1.0778
(t-statistic)	-2.86	4.05		-0.66	0.86	2.42	-0.11	-2.92	-6.16	0.39	0.06	-0.40
Fiscal Balance Forecast												
Budget (β_0)	0.3018	-0.6603	-0.7459	1.6933	-0.6804	-0.2732	…	0.2558	…	…	3.0585	5.3721
(t-statistic)	0.51	-0.78	-0.87	5.37	-3.43	-0.86	…	1.23	…	…	1.57	2.86
Consensus (β_1)	0.5097	1.4235	1.5208	-0.5001	0.3713	1.1442	…	0.6480	…	…	-1.1826	-4.9973
(t-statistic)	1.21	1.88	1.89	-1.75	3.30	3.52	…	4.63	…	…	-1.00	-2.49

Source: Staff calculations. See Appendix II for a description of the underlying methods.

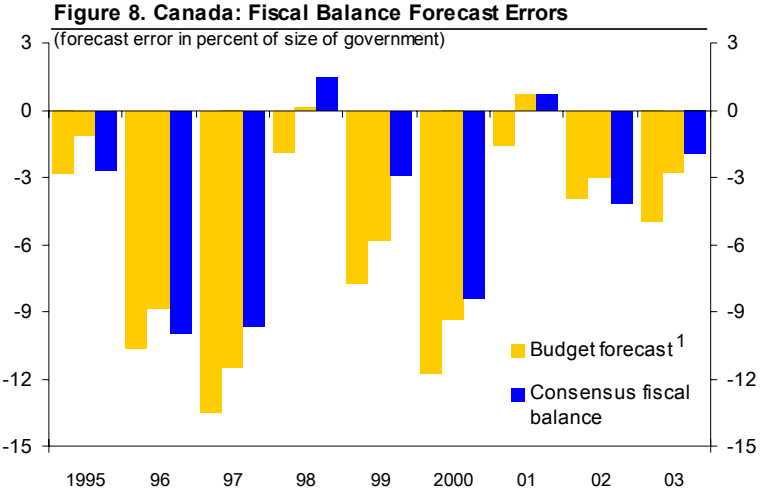
1/ Tests using budget projections of the overall balance (left column) and underlying balance (i.e., projected revenues less expenditures, excluding economic prudence and contingency reserve; right column)
2/ Ashley test. Null hypothesis is that the RMSE of the budget and Consensus forecasts are identical.
3/ The test probes whether both the budget and Consensus forecasts contain unique information.

Factors affecting forecast errors

49. ***Finally, this paper attempts to relate forecast performance to major characteristics of the fiscal environment, as well as measures of underlying economic volatility***. This approach follows Strauch, *et al.* (2004) who analyzed whether budget forecasts by EMU countries were influenced by elections or institutional factors. Accordingly, some of the information collected in sections B and C of this paper has also been used for empirical testing (a list of variables is contained in Table 11)

50. ***The paper also tests the hypothesis that strong fluctuations in a country's economy could affect the accuracy of budget forecasts***. For example, commodity-exporting countries like Australia, Canada, and New Zealand could be expected to suffer from larger and more frequent exogenous shocks than other countries. Given the difficulties of economic models in predicting turning points, this could make economic projections more difficult.

Figure 8. Canada: Fiscal Balance Forecast Errors



Source: Staff calculations.

[1] First bar indicates forecast error including prudence and contingency reserve; the second bar indicates forecast error for the operational balance (i.e. excluding prudence and contingency reserves).

51. ***Indeed, Canada has experienced greater macroeconomic volatility than many other countries***:

- ***Overall, Canada registered the third highest output volatility among benchmark countries between 1990 and 2003*** (Table 12). Short-term interest rates also fluctuated relatively strongly during that period, but other macroeconomic variables, including consumer price inflation, business sector wages, and the nominal effective exchange rate remained comparatively stable.

- ***However, fiscal aggregates have not been significantly more volatile than in other countries***. Volatility in Canada's expenditure-to-GDP ratios was higher than in many benchmark countries. This could partly reflect policy-induced changes in the expenditure ratio, such as cutbacks in spending on economic affairs (subsidies) and social protection related to consolidation in the 1990s, as well as sharp reductions in public debt payments. By contrast, Canada's revenue volatility (measured relative to the size of GDP) has been lower than in any of the other ten countries—with the

Table 11. Potential Factors Affecting Forecast Outcomes

Federal structure (dummy variable)	Presence of a federal political structure.
Fiscal rule (dummy)	Presence of a fiscal rule (see Table 4).
Expenditure ceiling (dummy)	Presence of a formal expenditure ceiling.
Deficit ceiling (dummy)	Presence of a formal deficit ceiling.
Appropriation	Share of budget expenditure subject to appropriation (midpoint of range; see Table 1).
Regulatory framework (dummy)	Number of aspects regulated by the constitution or by law (see Table 1).
Budget reporting	Number of OECD Best Practices met (see Table 1).
Accountability framework (dummy)	Positive response to the question whether a formal comparison is made between the medium-term fiscal policy objectives and the government's annual budget with explanations given for any deviations.
Performance assessment (dummy)	Regular, occasional, or no external ex-post assessment of forecasting performance (see Table 6).
Budget lead time (dummy)	Average number of months between submission of the budget and the budget vote (see Table 1).
Prudential framework (dummy)	Combination of "Prudential framework 1" and "Prudential framework 2."
Prudential framework 1 (dummy)	Positive response to the question whether there is an explicit "prudence" factor built into the economic assumptions which reduces the final economic estimates by a set amount?
Prudential framework 2 (dummy)	Positive response to the question whether growth assumption underpinning the medium term fiscal framework contains a margin of "prudence" vis-à-vis the forecast.
Stable tax revenue	Average share of personal income, social security, and indirect tax revenue in total revenue (1991-2002)
Mandatory expenditure	Average share of mandatory expenditure in total central government expenditure.
Transfers	Share of transfer payments to sub-national governments in total central government expenditure (see Table 3)

Sources: OECD/WB (2003); staff calculations.

exception of corporate income tax revenue, which may have been particularly affected by export volatility.[55]

[55] For comparing volatility across countries, fiscal aggregates have been divided by GDP. Sources of volatility include policy changes, such as enhanced public expenditure programs in the United Kingdom since 2000, expenditure cuts in Canada or Sweden during the 1990s, or tax cuts in the United States. The results are not corrected for this fact, both because it can be argued that volatility stemming from policy changes also contributes to a more difficult forecasting environment, and because estimates of non-policy induced volatility are not available for most countries.

Table 12. Volatility of Macroeconomic and Fiscal Variables, 1990- 2003

	Australia[1]	Canada	France	Germany[2]	Italy[3]	Netherlands	New Zealand	Sweden	Switzerland	U.K.[4]	U.S.	Rank Canada
Macroeconomic Variables				(standard deviation of annual percent changes, unless specified otherwise)								
GDP, real	1.5	2.1	1.3	1.2	1.1	1.6	2.2	2.2	1.5	1.5	1.4	3
Private consumption[5]	0.8	0.5	0.3	0.3	0.3	0.4	2.1	0.3	0.2	0.5	0.6	4
Public consumption[5]	0.2	0.4	0.3	0.3	0.3	0.3	0.5	0.5	0.2	0.3	0.2	3
Gross capital formation[5]	2.0	1.5	1.3	1.0	1.1	1.1	2.2	1.8	1.6	0.9	1.0	5
Change in inventories[5]	0.8	0.8	0.6	0.5	0.5	0.6	0.8	0.8	1.0	0.4	0.4	4
Exports of goods & services[5]	0.9	1.9	1.1	1.4	1.3	2.1	0.8	1.9	1.7	0.8	0.5	3
Consumer price index	1.9	1.4	0.8	1.1	1.6	0.7	1.3	3.2	1.9	2.1	1.0	6
Short-term interest rate in percent	4.6	4.1	3.8	2.6	5.4	2.6	5.4	3.8	2.5	3.7	3.8	4
Nominal effective exchange rate	6.5	3.4	3.2	3.6	6.3	3.0	7.7	6.6	4.0	5.8	4.9	9
Tax Revenue				(standard deviation of percentage shares in GDP)								
Total tax revenue	1.5	0.9	1.0	1.3	1.5	2.2	1.4	2.2	1.6	1.2	1.3	11
Taxes on income, profits and capital gain	1.1	0.9	1.9	0.7	0.8	1.8	1.0	1.3	0.5	1.0	1.3	8
Of individuals	0.7	0.9	1.4	0.6	0.4	2.2	1.1	1.2	0.3	0.6	1.1	6
Of corporations	0.7	0.8	0.5	0.3	0.5	0.5	0.7	0.7	0.4	0.7	0.4	1
Social security contributions	...	0.2	1.3	0.7	0.8	1.3	...	0.9	0.5	0.1	0.1	7
Taxes on payroll and workforce	0.1	...	0.1	...	...	...	...	0.9	...	...	...	...
Taxes on property	0.1	0.2	0.3	0.1	0.6	0.2	0.2	0.2	0.2	0.5	0.1	6
Taxes on Goods and Services	0.5	0.3	0.4	0.5	0.3	0.4	0.3	0.4	0.7	0.3	0.1	10
Central Government Expenditure												
Total expenditure	1.1	3.3	2.1	1.7	...	4.0	...	3.7	1.5	2.5	0.7	3
General public services	0.5	0.8	...	0.9	...	0.8	...	1.6	0.3	0.8	0.7	3
of which: Public debt transactions	0.2	1.1	...	0.3	...	0.9	...	...	0.1	...	0.6	1
Defense	0.2	0.3	...	0.3	...	0.3	...	0.3	0.2	0.6	0.8	5
Economic affairs	0.3	0.5	...	0.3	...	0.4	...	1.4	0.2	0.6	0.4	3
Education	0.3	0.2	...	0.0	...	0.4	...	0.8	0.0	0.3	0.1	5
Health	0.2	0.5	...	0.4	...	1.3	...	0.4	0.2	0.3	0.5	2
Housing and community amenities	0.1	0.1	...	0.1	...	0.8	...	0.9	0.0	0.2	0.1	7
Public order and safety	0.0	0.0	...	0.0	...	0.2	...	0.1	0.0	0.1	0.1	5
Social protection	0.8	1.3	...	1.5	...	0.9	...	2.6	1.2	1.1	0.4	3

Sources: *IMF World Economic Outlook; IMF Government Finance Statistics; OECD Revenue Statistics;* Fund staff calculations.

[1] Revenue data available thorugh 2002.
[2] Excluding 1991 and 1992 for GDP and its components.
[3] Expenditure data available thorugh 2000.
[4] General government. Data available through 2002.
[5] Standard deviation of contributions to real GDP growth.

52. ***The results suggest that structural characteristics of the fiscal environment have limited explanatory power for cross-country differences in forecast errors***. For the most important variables contained in budget forecasts, a series of simple OLS regressions of mean errors (MEs) and RMSEs on a constant and one of the structural variables yields few significant results (Table 13).[56] The conservative stance of Canada's forecasts is consistent with some of the findings, but there are also counter-intuitive relationships:

- For example, there is some evidence that stronger accountability reduces the RMSE for the growth and tax revenue forecast, but a federal structure has the opposite effect.
- In countries where the budget is presented to parliament early, revenues appear to be harder to forecast. However, this result may be influenced by a coincidence with recent policy shifts in the United States, which has the largest budget lead time.
- There is weak evidence that deficit and expenditure ceilings coincide with conservative revenue estimates.
- Fiscal rules are associated with overly optimistic forecasts, albeit the same applies to countries with a high share of voted appropriations. A higher share of mandatory expenditure is positively correlated with the forecast error for government spending.[57]

53. ***On the other hand, the evidence that forecasts tend to be more conservative in the presence of macroeconomic and fiscal volatility is relatively strong***. Especially a more volatile GDP growth environment pushes growth and, by implication, revenue forecast errors downward while leaving expenditure forecasts unaffected.

54. ***In some equations, volatility indicators and institutional features were found to be jointly significant***. A combination of growth volatility and prudence indicators was found to provide the best explanation for fluctuations in mean errors and RMSEs across benchmark countries, with volatility being consistently and more strongly significant across the range of regressions carried out. Paradoxically, a more formalized accountability framework and stricter requirements for assessing fiscal policy were found to be associated with overly optimistic expenditure forecasts. This may be due to "adverse selection"—formal accountability may have been strengthened particularly in countries with expenditure discipline problems.

55. ***It remains unclear whether these findings can fully explain the difference between forecast errors in Canada and other countries***. On the one hand, the existence of a mean error/bias for growth and revenue forecasts in Canada appears to be fully explained by a combination of prudence indicators and macro volatility. For example, the predicted value for the mean error of Canada's nominal GDP forecasts is close to the actual value (Figure 9),

[56] Each of these regressions is run with a maximum sample of only 11 observations, depending on the number of countries for which information was available.

[57] The results are robust in the sense that they hold even if different countries are removed from the sample.

Table 13. Bivariate Regressions of Error Characteristics on Structural and Volatility Indicators[1]

	Nominal GDP		Real GDP Growth		Revenues		Tax revenues		Expenditure		Revenue-to-GDP ratio		Expenditure-to-GDP r	
	ME	RMSE	ME	RMSE	ME	RMSE	ME	RMSE	ME	RMSE	ME	RMSE	ME	RMSE
Structural indicators														
Federal structure	0.0070	0.0096 **	-0.1760	0.0077	0.0045	0.0206	0.0015	0.0292 **	0.0035	0.0000	0.2912	-0.4945	-0.0019	-0.2420
Fiscal rule	0.0041	-0.0040	0.5337 *	-0.0432	-0.0050	-0.0011	-0.0018	-0.0149	0.0021	0.0063	-0.1991	0.0384	-0.0148	-0.0285
Expenditure ceiling	-0.0088	0.0031	0.3155	0.1453	-0.0188 *	0.0146	-0.0096	-0.0116	-0.0033	0.0087	-0.8202 **	1.2463 **	-0.4762	0.1658
Deficit ceiling	0.0032	-0.0002	0.3353	-0.1746	0.0035	-0.0294	0.0009	-0.0219	0.0069	-0.0169 *	0.1124	-0.2594	0.2671	-0.3957
Appropriation	0.0002	-0.0001	0.0128 **	-0.0001	0.0000	-0.0001	0.0002	-0.0004 *	0.0000	0.0000	-0.0091	0.0102	-0.0063	-0.0003
Regulatory framework	0.0011	0.0014	-0.1038	-0.0058	0.0028	0.0061	0.0037	0.0058 *	-0.0005	0.0010	0.0743	-0.0607	-0.0085	0.0037
Budget reporting	-0.0026	0.0011	-0.0996	0.0244	0.0000	-0.0016	-0.0017	0.0015	0.0013	-0.0044 *	0.1069	-0.1003	0.0963	-0.1390
Accountability framework	-0.0064	-0.0042	0.2385	-0.2998 *	-0.0059	-0.0084	-0.0088	-0.0311 **	-0.0072	0.0006	-0.2748	0.5084	-0.2500	0.0193
Performance assessment	-0.0078	0.0062 *	-0.3094	-0.0051	-0.0031	0.0217	-0.0006	0.0172	-0.0062 *	0.0061	-0.1379	0.4524	-0.2675	0.0731
Budget lead time	0.0025	0.0025	0.0819	0.0470	0.0051	0.0146 **	0.0070 *	0.0102 **	-0.0020	0.0049	-0.0276	0.2636	-0.1789	0.0989
Prudential framework	-0.0085	-0.0036	-0.3218	0.1132	-0.0169	0.0135	-0.0066	-0.0037	0.0023	0.0133	-0.3665	0.4856	0.1908	0.5978
Prudential framework 1	-0.0135	0.0020	-0.3432	-0.0553	-0.0169	0.0269	-0.0066	-0.0037	-0.0010	0.0144	-0.3666	0.7663	0.0457	0.4786
Prudential framework 2	-0.0022	-0.0078	-0.0506	0.0097	-0.0074	0.0107	0.0062	-0.0103	-0.0013	0.0145	-0.4005	0.7496	0.0169	0.7841
Stable tax revenue	0.0234	-0.0145	2.5825	1.3153	0.0578	-0.0278	0.1054	-0.0204	0.0069	-0.0252	-0.8951	3.0604	-0.5694	-0.1453
Mandatory expenditure	0.0001	0.0001	0.0104	-0.0002	0.0001	0.0009	0.0001	0.0004	-0.0003 *	0.0006 **	-0.0052	0.0138	-0.0164 *	0.0069
Transfers	-0.0004	0.0005	-0.0315	0.0058	-0.0013 *	0.0028 **	-0.0005	0.0009	0.0000	0.0011	-0.0307	0.0391	-0.0118	0.0234
Volatility measures														
Real GDP growth	-0.0231 **	0.0076	-0.2808	0.1122	-0.0273 **	-0.0063	-0.0352 **	-0.0143	0.0051	-0.0079	-0.3234	0.4056	0.1983	-0.2825
Export growth	-0.0020	0.0035	0.4221	0.1278	-0.0196 **	0.0215	-0.0131	-0.0036	-0.0005	0.0162 *	-0.6616 **	0.6377	-0.3788	0.1040
CPI inflation	-0.0087	0.0021	0.0549	-0.0742	-0.0113 *	-0.0179	-0.0197 **	-0.0071	0.0077 **	-0.0094	0.1103	-0.1832	0.3666 *	-0.1804
Tax revenue	-0.0048	0.0051	0.5321	0.0816	-0.0178	0.0284	-0.0112	0.0017	-0.0037	0.0192 *	-0.8355 **	1.4263 **	-0.6057 *	0.4900
Personal income tax revenue	-0.0097	0.0028	0.0945	0.0547	-0.0033	0.0289 *	0.0045	0.0046	-0.0129 **	0.0176 **	-0.5089 *	1.2209 **	-0.6321 **	0.3755
Corporate income tax revenue	-0.0657 **	0.0039	-1.4740	-0.2099	-0.0740 **	-0.0564	-0.0992 **	-0.0544	0.0069	-0.0103	-0.4620	0.0240	1.0707	0.0968
Social insurance tax revenue	0.0102	-0.0070	0.8079 **	0.0033	0.0002	0.0061	0.0068	-0.0179	-0.0148 **	0.0189 *	-0.7551 **	0.7311	-0.9367 **	0.1815
Indirect tax revenue	0.0731 **	-0.0115	2.3091 **	-0.7592	0.0132	-0.0047	0.0251	-0.0867	-0.0073	0.0091	-0.6748	-1.3401	-1.4510	-1.1062
Expenditure	-0.0068	0.0001	0.0748	0.0465	-0.0104 **	0.0026	-0.0074	-0.0074	-0.0010	0.0056	-0.3106 **	0.4271 *	-0.0782	0.1328

Source: Staff calculations. See Table 12 for a definition of structural indicators. Volatility measures are taken from Table 11.

[1] Table reports results of regression of error measures in top row on variable listed in the left column over all countries in the sample (estimated constants are not reported). Asterisks denote significance at the 10 and 5 percent significance level, respectively.

suggesting that forecasters in other countries would on average arrive at the same outcome if they were operating in Canada's forecasting environment. On the other hand, the RMSE—which is a better measure for overall forecast quality—appears little affected by macro volatility, and Canada remains the country with the second highest residual in the bottom chart of Figure 9. Further research—based on more comprehensive data and more refined economic models—would be needed to shed greater light on the relationship between the fiscal forecasting environment and forecast accuracy.[58]

Figure 9. Impact of GDP Volatility on Forecast Quality
(forecast errors of growth rates in annual percent change)

Source: Staff calculations.
[1]Estimation of the mean error between real GDP growth forecasts and the actual results regressed against the volitility of real GDP growth and the budget lead time.
[2]Estimation of the root mean squared error between real GDP growth forecasts and the actual results regressed against the volitility of real GDP growth and prudence indicators.

F. Conclusion

56. ***The results of this study suggest that Canadian budgets have followed a cautious forecasting approach in recent years***. A descriptive analysis shows Canada with larger and more conservative fiscal forecast errors than most other countries. The study also finds that Canada's aggregate forecast error is composed of small but consistently one-sided errors in fiscal subcomponents, which appears characteristic of a conservative forecasting approach.

57. ***A considerable part of this outcome appears related to a forecast bias in the macroeconomic component.*** This finding may be partly a consequence of Canada's economic environment, given the link between macroeconomic volatility and pessimistic growth projections established in the last section. Moreover, Canadian forecasters were not unique in underestimating the global boom of the late 1990s. Although prudence adjustments in budgets of the mid- to late 1990s also led to a slight increase in forecast

[58] Panel estimations are particularly affected by data shortcomings and have added little additional information. However, time dummies for the late 1990s have generally been significant in regressions covering fiscal variables, suggesting that surprises from a strong global growth environment have not been confined to Canada.

errors, macro projections were likely affected by the fact that Canada unexpectedly outperformed other industrial countries throughout much of the period.

58. ***However, other factors are also likely to have played a role***. Budget forecasters have had to cope with considerable ex-post uncertainty relating to the size of provincial transfers and tax-sharing arrangements, which were exacerbated by the relatively large size of provincial budgets relative to the federal government. Moreover, the economic literature suggests that a conservative budgeting approach constitutes a rational response to a regime where the costs of missing a fiscal target are both high and asymmetric, as has been the case in Canada over the past ten years.

59. ***Canada could benefit from further improving the transparency of its budgetary forecasts***. Given the importance of restoring public confidence in government finances in the mid-1990s, the consequences of running into deficit were considerably higher than those of achieving a surplus. As Canada's fiscal situation has improved, it is unclear to what extent the relative costs of missing budget targets have changed. However, Canada could benefit from opening up the forecasting process, e.g., by involving private forecasters in producing revenue estimates. Equally important, providing more information about critical parts of the forecasting process—in particular the assumptions and methods used for transforming macroeconomic forecasts into fiscal projections—would invite greater outside scrutiny, helping to improve forecast quality and bolster public confidence in budget projections.[59]

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[59] Examples include Australia and New Zealand, which have adopted transparency legislation to boost public understanding of fiscal forecasts, whereas in other countries—such as Germany and the Netherlands—academic bodies or independent agencies participate in the forecast. IMF (2002) also provides suggestions for expanding the information content of the *Economic and Fiscal Update*.

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Data Overview

Australia

Annual budgets are usually presented in May, two months before the start of the fiscal year in July. Forecast data begins with the 1984/85 budget.

- Budgets present activities of the general government, which includes central, state/territory and local governments.
- Beginning in the 1999/00 fiscal year, Australia moved from a cash to an accrual accounting basis, but subsequent budgets reported most items on both a cash and accrual basis. For the sake of consistency, the data set uses cash forecasts for all fiscal variables, except interest expenses which from 1999/00 to 2004/05 were only available on an accrual basis. In FY 1999/00 and FY 2000/01, individual, corporate, indirect, and other taxes are omitted from the data set because they were not reported on a cash basis.
- Fiscal years 1984/85 through 1993/94 did not report revenue projections beyond the budget year, i.e. two-year projections are omitted. Projections for real GDP growth and unemployment are also limited to the next fiscal year.
- Final outcomes for FY 1996/97 were not reported in the FY 1998/99 budget and had to be substituted with estimates reported in the FY 1997/98 budget.

Canada

Data were provided in electronic form by the Department of Finance. Canadian budgets are usually published in February, two months before the start of the fiscal year on April 1.

- Projections for FY 2000-01 come from the Budget Update for FY 1999-2000, which was published in October 2000.
- Mandatory expenditures includes transfer payments; discretionary expenses are defined as program costs.
- Actual outcomes are generally taken from annual financial reports of the government. Annual financial reports are published sufficiently long after the close of the fiscal year to properly estimate accruals transactions.

France

Data were provided in electronic form by French national authorities. French budgets are usually published in September, with the fiscal year starting on January 1.

- Forecast data begins with FY 1996. Personal income, corporate income, excise and other tax revenue data are not available for FY 1996 and FY 1997.

Germany

German budgets are published in September, with the next fiscal year starting on January 1.

- Forecast data begins with FY 1990. Variables directly affected by the 1990 reunification have been omitted.
- Data on mandatory expenditures comprises government wages and salaries and transfer payments. Discretionary expenditures include acquisition of goods and services and capital spending.

Italy

Italian budget proposals are published in the "Documento di Programmazione Economico-Finanziaria" (DPEF) between May and July, half a year before the start of the next fiscal year in January. Data provided by the national authorities reached back to FY 1989.

- Personal and corporate income, excise, and other tax revenue data are not available.
- Central government ("Bilancio") data for FY 2000 and FY 2001 were not available.
- For FY1990 - FY1998, DPEFs did not report final outcomes for either fiscal or macroeconomic variables, so estimated outcomes from the previous budget are used as the final outcomes.

Netherlands

Data were provided in electronic form by Dutch national authorities. Dutch budgets are published in September, with the fiscal year starting on January 1.

- Forecast data begins with FY 1995, and covers general government.
- Most projections were limited to the one-year time frame.

New Zealand

New Zealand publishes its "Budget Economic and Fiscal Update" (BEFU) in May, prior to the start of the fiscal year on July 1. Growth and unemployment data were pulled directly from BEFU documents; all other observations came from: http://www.treasury.govt.nz/fiscaldata/default.asp.

- Projection data was available for fiscal years 1994/95 through 2004/05, except for growth and unemployment projections which begin with FY 1998/99.

Sweden

Outcome and projection data for Sweden were taken from "Appendix 2: Svensk Economi" of the annual budget bill. The bill is published in September, four months prior to the start of the next fiscal year on January 1. Data were available for FY 1997 through FY 2005, with the exception of FY 2000.

- Revenues and the fiscal balance were provided on a general government basis. Budgetary expenditure is on a central government basis.
- Data for personal income, corporate income, excise and other tax revenue were not available for FY 1997 and FY 1998.

Switzerland

Data were provided in electronic form by Swiss national authorities. Swiss budgets are published in October, with the fiscal year beginning on January 1.

- Forecast data begin with FY 1990.
- Data for personal income, corporate income, excise and other tax revenues were not available.

United Kingdom

The U.K. government usually publishes its "Budget Report" in March, shortly before the start of the fiscal year in April. Data only covers budgets published under the current framework since FY 1997/98.

- The "Budget Report" refers primarily to the public sector, although general government aggregates are shown for most years.
- The current UK fiscal framework separates the current and capital budget. For consistency purposes, current and capital expenditures were consolidated. Total outlays are the sum of current expenditure and net investment.
- The headline balance concept used was "Net borrowing" inclusive of net windfall tax receipts and associated spending (WTAS), asset sales and depreciation.

United States

Federal government data was obtained from "Historical Tables: Budget of the U.S. Government", which is usually published in February, 8 months before the start of the next fiscal year on October 1.

- Interest expense is recorded on a net basis.
- For FY 1984/85 through FY 1990/91, mandatory spending was defined to as "total, relatively uncontrollable outlays" and discretionary spending as "total, relatively controllable outlays."
- Prior to FY 1990/91, nominal output is reported as gross national product. Beginning with FY 1990/91, nominal output is reported as gross domestic product.

Consensus forecasts

Private sector forecast data for real GDP growth rate (calendar year basis) and the headline budget deficit value (in local currency) come from Consensus Economics, Inc. Consensus Economics publishes updated estimates for the current and next calendar/fiscal year every month. The data for this study are drawn from the month in which authorities released their budget documents.

Methodological Details

Descriptive statistics

Given that most budgets contain at least 3-4 years of information for any major economic and fiscal variable, budget data was used to create the following time series:

$$\{x_t^{-2}\}, \{x_t^{-1}\}, \{x_t^{0}\}, \{x_t^{1}\}_{t=1,\ldots,T} \tag{1}$$

where x stands for variables projected in budget documents, for example, real GDP growth, tax revenue, or the fiscal balance. The subscript t denotes the budget year (i.e., the first year which is fully covered by the budget forecast) and the superscript denotes a year relative to the budget year. For example, $\hat{y}_{2001}^{-2}$ would denote the value for real GDP growth in FY 1999 reported in the FY2001 budget.

Forecast errors are defined as the difference between forecasts and actuals reported in later budgets. In the above notation, the one- and two-year ahead forecast errors are:

$$e_t^0 = \log(x_t^0) - \log(x_{t+2}^{-2}), \tag{2}$$
$$e_t^1 = \log(x_t^1) - \log(x_{t+3}^{-2}).$$

In other words, this study uses historical values reported in the budget two years later to evaluate the accuracy of the forecast for the budget year (i.e., one-year forecast), and three years later for the two-year forecast. For completeness, the difference between the estimated value of a variable in the base year and the actual value reported one year later is defined as:[60]

$$e_t^{-1} = \log(x_t^{-1}) - \log(x_{t+1}^{-2}) \tag{3}$$

The logarithmic notation implies that projection errors for nominal variables are expressed in percentage points of actual outcomes, and errors for growth rates in first differences.[61]

The paper also uses a decomposition of the nominal GDP forecast into its base and growth components. The one-year nominal GDP forecast error can be approximated as the error in estimating base year GDP (e^{-1}) and the one-year projection errors of real GDP growth and GDP inflation ($e_{\hat{y},t}^0$ and $e_{\hat{p},t}^0$, respectively). It approximately holds that:

[60] Usually, information on the base year is limited to a few months only.

[61] The forecast error for the fiscal balance is defined as the difference in projected and actual value, scaled by the average of government revenues and expenditures. Forecast errors for the unemployment rate and fiscal GDP ratios are expressed as first differences.

$$e^0_{Y,t} = e^{-1}_{Y,t} + e^0_{\hat{y},t} + e^0_{\hat{p},t}, \quad (4)$$

highlighting that errors made in estimating base year nominal GDP can also significantly affect the one-year forecast.

Countries' budget projections are compared on the basis of their mean error (ME) and root mean squared error (RMSE).[62] These are defined as:

$$ME_i = 1/T \sum_{t=1,...,T} e^i_t, \quad RMSE_i = \left(1/T \sum_{t=1,...,T} {e^i_t}^2 \right)^{1/2} \quad (5)$$

It holds that the squared RMSE is equivalent to the sum of the squared mean error and the error variance:

$$RMSE^2_i = ME^2_i + \sigma^2_{e^i} \quad (6)$$

Bias and efficiency tests

Several methods are available to test for forecast bias, which is defined as a nonzero median or mean error. This study employs three nonparametric *median* tests, including:

- a binomial sign test, which checks whether the sample proportion both above and below zero is equal to one-half;
- a Wilcoxon signed ranks test, which postulates that the sum of ranks of the absolute error sizes should be similar for subsamples with above and below zero outcomes;
- a van der Waerden test, which is a variation of the Wilcoxon test that uses quantiles of the normal distribution to smooth ranks.

Mean tests are conducted by running a regression of the error terms on nothing but a constant, and testing whether the constant is significantly different from zero. To allow for the possibility of serially correlated shocks (which would indicate inefficiency, see below) and nonstandard error distribution, mean tests are also run with Newey-West residuals following an AR(1) process.[63]

[62] Another measure often used in evaluating forecast accuracy, Theil's inequality coefficient, was not computed. This measure divides the RMSE by the standard deviation of the growth rate of the underlying variable. Calculating the latter would have resulted in a further drop in the number of observations available for analysis.

[63] The power of statistical tests based on complex distributional assumptions is limited by the small number of observations. Their main purpose is to provide a robustness check for tests using simpler assumptions.

Efficiency tests analyze whether the null hypothesis of uncorrelated or normally distributed forecasts errors can be rejected. This hypothesis is first tested by regressing the actual value of a variable on a constant and its projected value:

$$\log(x_{t+2}^{-2}) = \alpha + \beta \log(x_t^0) + \varepsilon_t \quad (7)$$

and testing the joint hypothesis of $\alpha = 0$ and $\beta = 1$ (Nordhaus, 1997). Second, forecast errors are tested for the presence of autocorrelation.

Budget vs. private sector forecasts

The difference in RMSEs of public and private sector forecasts can be tested for statistical significance, following the approach in Ashley, *et al*. (1980). The test uses the regression

$$\Delta_t = \alpha + \beta\,(\Sigma_t - \overline{\Sigma}) + \varepsilon_t \quad (8)$$

where Δ_t stands for the difference of government and private sector forecast errors in budget year t, and Σ_t for their sum ($\overline{\Sigma}$ is the average of Σ_t over time). The difference in forecast errors is significant if a Wald test rejects the restriction that $\alpha = \beta = 0$. The distribution of the Wald test statistic is nonstandard, given the presence of serial correlations in most forecasts. Ashley, *et al*. (1980) note that, in this case, probability values are at most about half their normal values, given that the test is one-sided once the sign of the mean errors is established.

Encompassing tests are used to test for statistical dominance of one set of forecasts over the other (Fair and Shiller, 1990). This test is based on the regression

$$x_{t+2}^{-2} = \alpha + \beta_0\, x_t^0 + \beta_1\, x_t^{0,C} + \varepsilon_t\,, \quad (9)$$

which regresses the actual value of a variable on both its government and private sector forecast (the superscript C denotes the consensus forecast). The coefficients β_0 and β_1 measure the information content of the two sets of forecasts. For example, if β_0 was not significantly different from zero, and β_1 significant and positive, then the private sector forecast would "encompass" the budget forecast, i.e., the budget outlook would not contain information not already contained in the consensus forecast.[64]

[64] This regression has been run with a White covariance matrix to account for possible heteroscedasticity.

PART III: STRUCTURAL ISSUES

V. How Flexible is the Canadian Economy? An International Comparison[65]

A. Introduction

1. ***The openness of the Canadian economy leaves it susceptible to external shocks and puts a premium on economic adaptability***. Accordingly, this paper compares the degree of flexibility of Canadian economy with that of other major industrialized countries. Flexibility is an important economic concept, but a difficult one to measure. Rather than focusing on one approach, this paper uses a range of different measures of economic adaptability:

- ***Industry-level data on real value added*** is used to compare the degree to which countries have changed their economic structure, both over long periods of time and from year to year. The latter is a measure of the amount to which resources flows across sectors in response to changes in economic conditions, which can be characterized as economic "churning."

- ***A survey of microeconomic studies*** compares rates of entry and exit of individual firms as well as gross job creation and destruction across industrial countries, and supplement the industry-level analysis of churning.

- ***Estimates of Phillips curves across countries*** measure the speed with which the economy responds to macroeconomic disturbances.

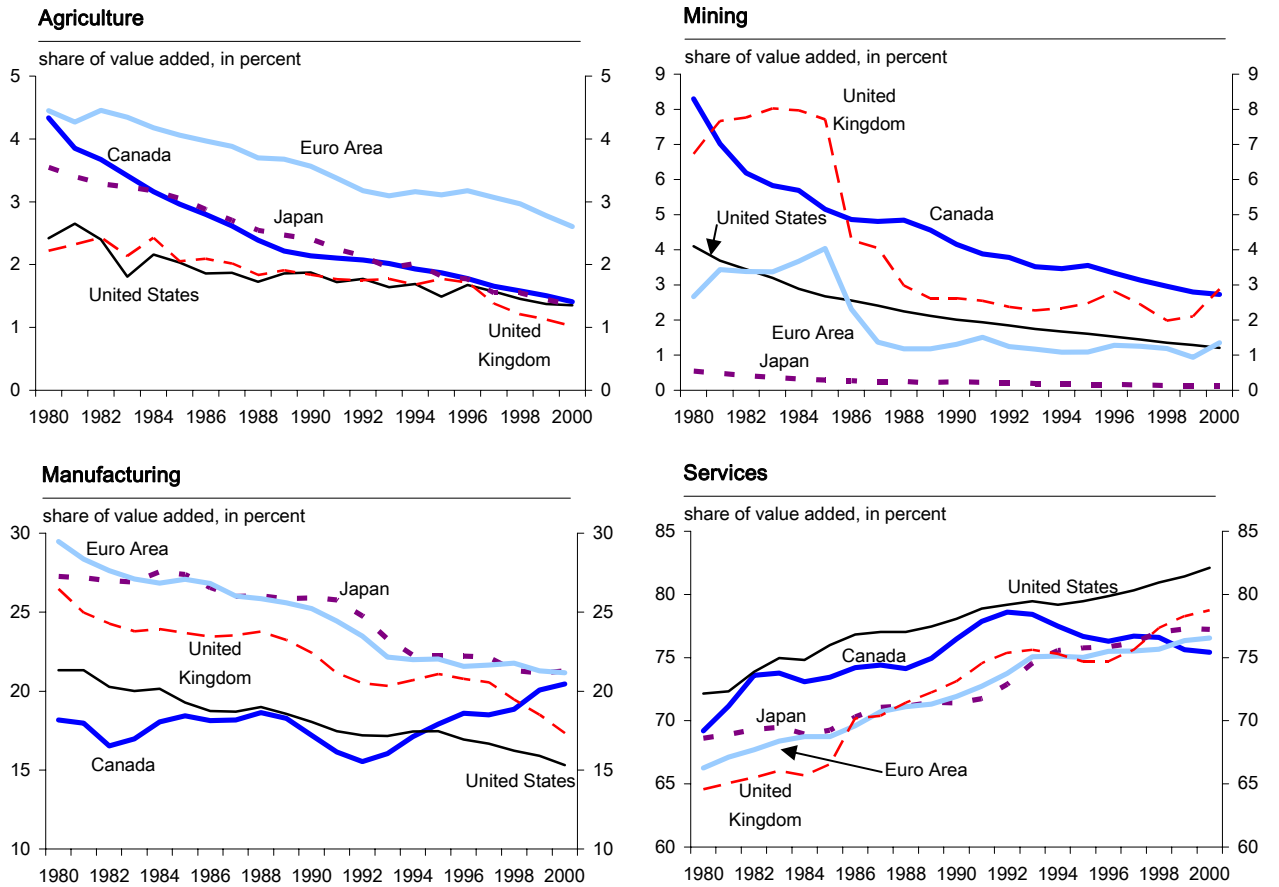
2. ***The results uniformly suggest that Canada is characterized by a relatively high degree of flexibility, of magnitude comparable if not larger than many other industrialized countries, with the likely exception of the United States.*** Industry-level data suggest Canada has undergone a deep transformation of its industrial structure over the last 20 years and that it has been able to respond rapidly from year to year to changing circumstances. In addition, a relatively large number of firms enter and exit the market every year, while the share of gross jobs created and lost in the Canadian manufacturing sector every year has been comparable to that in the United States. Phillips curves also point to a relatively strong ability to respond to macroeconomic disturbances.

B. Industry Data

3. ***The Canadian economy has undergone substantial structural changes over the past 20 years, largely reflecting the declining importance of the primary sector***. Figure 1 shows that the share of value added of the Agriculture and Mining sectors has declined more rapidly in Canada than in other industrialized countries over this period (Figure 1). In contrast with other countries, the manufacturing sector's share has increased over time, while the service sector's share has not increased as rapidly.

[65] Prepared by Tamim Bayoumi and Roberto Cardarelli (RES).

Figure 1. Sectoral Change Across Countries



Source: OECD, Structural Analysis Database.

4. ***Standard indexes suggest that Canada has been relatively successful in shifting resources across sectors***. Two measures of structural change in response to disturbances are the Structural Change Index (SCI), which measures changes over extended periods, and the Lilien index, which focuses more on short-term churning (Box 1, Table 1). The Lilien Index suggests that Canada has experienced more churning across sectors than other G-7 countries, as well as the Netherlands, and Spain, but Canada scores lower on the SCI measure of long-term structural change.[66]

[66] Germany is excluded from the comparison due to the impact of reunification.

Box 1. Indexes of Structural Changes

The Structural Change Index, which measures change over extended periods, is given by:

$$\text{SCI} = \frac{1}{2}\sum_{i=1}^{N}\left|\ln s_{i,T} - \ln s_{i,t}\right|$$

where $s_{i,t}$ is the real value added of sector $i=1...N$ at time t. The index is calculated over three different time periods (for example, the index for the period 1980-2000 is based on the difference between shares in 2000 and those in 1980). To make the index less dependent on the business cycle, industry shares are averaged over 4 years at the beginning and end of the relevant period (for example, averages over 1980-83 and 1997-2000).

The Lilien Index, which focuses more on churning across sectors, is given by:

$$\text{L} = \frac{1}{T-1}\sum_{t=1}^{T}\left[\sum_{i=1}^{N}\left(\frac{s_{i,t}}{s_t}\right)\left(\Delta \ln s_{i,t} - \Delta \ln s_t\right)^2\right]^{1/2}$$

where s_t is the real value added for the economy/manufacturing.

Table 1. Indexes of Structural Change

	Index of Structural Change (SCI): Real Value Added						Lilien Index of Structural Change: Real Value Added					
	Total			Manufacturing			Total			Manufacturing		
	1980-1990	1990-2000	1980-2000	1980-1990	1990-2000	1980-2000	1980-1990	1990-2000	1980-2000	1980-1990	1990-2000	1980-2000
Canada	6.6	6.6	12.1	1.2	2.2	2.3	6.6	6.1	6.3	4.9	5.3	5.1
United States	5.6	5.6	11.2	1.5	1.4	3.1	4.9	3.8	4.3	3.5	2.7	3.1
United Kingdom	8.8	6.8	16.5	1.7	1.5	3.6	6.0	5.5	5.7	3.1	3.2	3.2
Japan	5.7	6.8	10.3	1.7	2.0	3.4	5.0	4.0	4.5	3.6	2.8	3.2
Italy	7.1	4.9	13.1	1.9	1.0	3.5	4.8	4.8	4.8	2.9	3.6	3.2
France	6.0	4.8	10.9	2.3	1.2	3.5	4.3	4.7	4.5	3.0	3.3	3.2
Netherlands	7.7	6.2	14.0	1.3	1.2	1.7	6.0	5.0	5.5	2.9	3.2	3.0
Spain	7.6	5.1	12.4	2.5	1.2	4.3	6.6	4.7	5.7	4.8	3.3	4.1

Sources: OECD, Structural Analysis Database; and Fund staff calculations.

5. ***Estimates that adjust for secular trends and persistence in shocks suggest that Canada has experienced more churning than other countries except for the United States***. The Lilien Index results for Canada could reflect the fact that it has been subject to relatively persistent shocks, leading to secular trends and more persistence in economic adjustment. To test for this, this paper estimates simple univariate regressions of the form:

$$\Delta VA_{it} = c_i + \rho_t \Delta VA_{it-1} + \varepsilon_{it} \qquad (1)$$

where VA is the logarithm of sectoral real value added.[67] The autoregressive coefficients (ρ_i), which measure the persistence of sectoral shocks, indeed suggest that Canadian shocks are relatively persistent across industries (Table 2), while the coefficient c_i takes account of secular trends in value added for each sector.[68] The standard deviation of the error term is then a measure of the churning across sectors (Table 3). The value for Canada is estimated to be lower than in the United States but somewhat higher than Japan, and considerably higher than the European countries.

Table 2: Median Unbiased Estimates of First Order Autoregressive Coefficient, Real Value Added
($\Delta VA = c + \rho\, \Delta VA(-1) + \varepsilon$) 1/

	Canada	United States	United Kingdom	Japan	France	Italy	Spain
Agriculture Forestry and Fishing	-0.06	-0.27	-0.37	-0.27	-0.69	-0.46	-0.02
Mining and Quarrying	0.15	0.00	0.46	0.02	– –	0.73	-0.08
Food products, beverages and tobacco	0.07	-0.24	-0.23	0.40	0.05	0.39	0.07
Textiles, textile products, leather and footwear	-0.07	0.14	0.28	0.62	-0.23	-0.09	0.17
Wood and products of wood and cork	0.31	0.53	0.35	0.19	-0.09	0.18	0.32
Pulp, paper, paper products, printing and publishing	0.25	0.09	0.64	0.59	0.18	0.39	0.09
Coke, refined petroleum products and nuclear fuel	-0.08	-0.33	-0.15	-0.50	0.69	-0.06	-0.01
Chemicals and chemical products	-0.01	-0.27	0.16	0.52	0.56	0.59	0.10
Rubber and plastics products	0.35	-0.28	0.41	0.42	0.30	-0.44	0.22
Other non-metallic mineral products	0.47	-0.08	0.42	0.07	-0.42	0.55	0.38
Basic metals	0.22	0.03	0.54	0.03	-0.28	-0.14	0.05
Fabricated metal products, except machinery and equipment	0.74	0.30	0.54	0.44	0.49	0.29	0.64
Machinery and equipment not elsewhere classified	0.37	0.19	0.14	0.49	-0.09	0.29	0.58
Electrical and optical equipment	0.68	0.50	0.45	0.46	1.07	0.24	0.48
Transport equipment	0.20	0.43	0.54	0.25	-0.23	0.27	0.11
Manufacturing not elsewhere classified	0.16	0.08	0.36	0.66	0.29	-0.08	0.48
Utilities	0.09	-0.02	-0.28	0.20	0.17	-0.05	0.09
Construction	0.51	0.52	0.35	0.87	0.43	0.54	0.68
Wholesale and retail trade; repairs	0.66	0.24	0.57	1.09	0.29	-0.04	0.55
Hotels	0.21	0.34	0.68	– –	0.50	0.09	0.24
Transport and storage	0.28	-0.06	0.26	0.64	0.03	0.26	-0.03
Post and telecommunications	0.47	0.31	1.04	0.44	-0.07	0.12	0.22
Financial intermediation	0.25	0.33	0.48	0.57	0.63	-0.24	0.53
Real estate activities	0.58	0.22	0.13	0.84	0.51	1.01	-0.06
Renting of machinery and equipment and other business activities	0.57	0.36	0.60	0.44	0.54	0.28	-0.17
Public admin. and defence; compulsory social security	0.43	1.02	0.56	0.45	-0.07	0.99	0.67
Education	0.42	-0.04	0.13	0.35	-0.44	0.09	0.35
Health and social work	0.43	0.13	0.26	0.30	0.39	0.28	0.61
Other community, social and personal services	0.07	0.38	0.47	0.39	0.08	-0.22	0.11
Average	0.30	0.16	0.34	0.39	0.16	0.20	0.25

Sources: OECD, Structural Analysis Database; and Fund staff calculations.
1/ Data are annual, covering the period 1981-2000.

[67] Annual data on sectoral real value added were taken from the latest version of the OECD's STAN database for the period 1981-2000.

[68] To avoid the finite sample downward bias affecting OLS estimates, the autoregressive coefficient has been estimated using Hansen' grid bootstrap method, which produces median unbiased parameter estimates (see Hansen, 1999).

Table 3: Standard Error of First Order Autoregressive Coefficient, Real Value Added
($\Delta VA = c + \rho \Delta VA(-1) + \varepsilon$) 1/

	Canada	United States	United Kingdom	Japan	France	Italy	Spain
Agriculture Forestry and Fishing	5.0	11.5	5.8	4.9	5.3	3.7	6.1
Mining and Quarrying	4.6	8.1	6.3	10.9	– –	5.6	6.4
Food products, beverages and tobacco	2.6	6.6	1.4	2.9	4.1	3.7	3.8
Textiles, textile products, leather and footwear	7.5	4.4	4.4	5.1	4.1	3.5	2.1
Wood and products of wood and cork	9.8	6.3	5.7	5.8	2.4	4.1	6.0
Pulp, paper, paper products, printing and publishing	6.1	3.4	3.1	4.1	1.3	3.6	5.4
Coke, refined petroleum products and nuclear fuel	6.2	17.7	7.2	10.4	15.2	19.0	5.7
Chemicals and chemical products	6.4	5.6	3.9	7.6	4.5	6.1	4.4
Rubber and plastics products	9.7	6.9	4.8	6.5	5.1	4.6	5.1
Other non-metallic mineral products	9.7	8.1	4.5	5.8	4.6	4.3	5.8
Basic metals	8.3	11.1	3.8	8.8	3.9	5.7	5.2
Fabricated metal products, except machinery and equipment	8.8	6.5	3.8	5.7	1.9	3.3	4.4
Machinery and equipment not elsewhere classified	11.0	14.0	4.5	8.5	4.1	4.7	6.6
Electrical and optical equipment	11.6	11.2	6.2	14.5	7.4	5.2	6.1
Transport equipment	11.3	7.0	4.5	6.0	9.3	7.2	8.0
Manufacturing not elsewhere classified	10.0	6.5	5.7	5.4	3.8	4.9	5.8
Utilities	3.8	5.3	6.8	3.9	5.8	3.7	4.8
Construction	4.3	5.2	4.7	3.9	4.8	2.7	5.7
Wholesale and retail trade; repairs	3.9	6.0	3.3	3.9	4.1	3.1	2.1
Hotels	5.2	3.7	3.2	– –	3.2	3.7	3.2
Transport and storage	4.8	4.9	4.3	3.5	3.8	3.2	3.8
Post and telecommunications	5.3	6.1	5.8	8.8	8.6	8.5	7.4
Financial intermediation	5.1	5.6	4.1	7.4	5.1	5.5	6.0
Real estate activities	2.4	3.4	1.9	2.7	2.5	2.2	3.0
Renting of machinery and equipment and other business activities	6.2	6.3	6.7	8.2	3.6	5.8	5.8
Public admin. and defence; compulsory social security	1.9	1.1	1.2	1.3	2.7	1.9	3.7
Education	1.7	3.0	1.7	1.8	2.3	0.8	3.6
Health and social work	1.9	2.7	3.1	3.2	2.0	2.6	3.5
Other community, social and personal services	3.5	3.8	4.1	2.4	2.4	3.8	3.9
Average	6.2	6.6	4.4	5.9	4.6	4.7	4.9

Sources: OECD, Structural Analysis Database; and Fund staff calculations.
1/ Data are annual, covering the period 1981-2000.

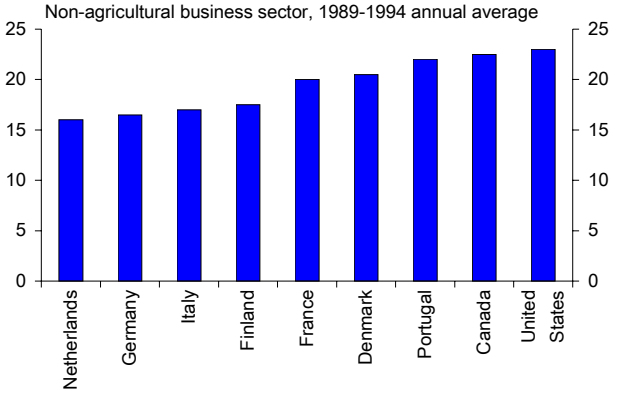
C. Firm-Level Data

6. ***Microeconomic studies have compared responses of Canadian firms to changes in the environment***. A scarcity of comparable cross-country data on firms' behavior restricts the scope for international comparison. However, some analysis has been performed on the demographics of firms across sectors and countries using data collected by the OECD. In addition, a Statistics Canada study has compared gross job flows—a measure of the relative flexibility of the labor market—between Canada and the United States.

7. ***The OECD firm-level study suggests that Canada has a relatively high amount of firm entry and exit*** (Figure 2). During the 1990s, firm turnover (entry plus exit rates) in the business sector was on average around 20 percent in Canada, a rate second only to the United States among the countries covered by the database (Bartselman *et al.*, 2003). Entering firms also had a relatively large probability of failing within the first two years.[69] These results suggest that it is relatively easy for small Canadian firms to obtain external financing and enter the market, where they face strong pressures.

Figure 2. Turnover rates in OECD countries

Non-agricultural business sector, 1989-1994 annual average



Source: OECD, Structural Analysis Database.

8. ***A study by Baldwin et al. (1998) also suggests that churning in the Canadian labor market is comparable to that in the United States***. About one in ten manufacturing jobs was created in Canada each year between the early 1970s and the early 1990s, and roughly the same number was lost each year. The reallocation rate—the sum of jobs created and jobs eliminated—was about 22 percent in Canada compared with 19 percent in the United States.[70] The study also suggests that much of the job reallocation in both countries reflected shifts in employment opportunities across firms in the same sectors, rather than between industries; and that the industries showing high (low) job creation and destruction in Canada also were the ones showing high (low) job reallocation in the United States. This supports that sectoral differences in the rate of job creation/destruction are mainly explained by common technological characteristics of the industries in the two countries.

D. Macroeconomic Data

9. ***An alternative approach to measuring flexibility is to look at relationships at the macroeconomic level***. A particularly simple characterization of the economy involves a Phillips curve, IS curve, and monetary reaction function.[71] A typical specification is:

$$\textit{Phillips curve: } \pi_t = \beta\pi^e_{4,t+4} + (1-\beta)\pi_{4,t-1} + \gamma y_t + \varepsilon^\pi_t \tag{2}$$

$$\textit{IS curve: } y_t = \delta_0 + \delta_1\left(i_t - \pi^e_{t+1}\right) + \delta_2 y^e{}_{t+1} + (1-\delta_2)\, y_{t-1} + \varepsilon^y_t . \tag{3}$$

$$\textit{Taylor rule: } i_t = \alpha_0 + (1-\rho_1-\rho_2)(\alpha_1\pi^e_{4,t+4} + \alpha_2 y_t) + \rho_1 i_{t-1} + \rho_2 i_{t-2} + \varepsilon^i_t . \tag{4}$$

[69] Results for Canada are discussed in Baldwin *et al.* (2000).

[70] These numbers are quite similar to those reported by Davis *et al.* (1996) for a series of other industrialized countries, ranging from 16 percent in Germany to 23½ percent for Sweden.

[71] See, for example, Clarida *et al*. (1998).

where π_t is the annualized quarterly CPI inflation rate, π_{4t} is the annual CPI rate of inflation, y_t is the output gap (measured by detrending real GDP using a Hodrick Prescott filter with a smoothing coefficient of 1,600), and i_t is the policy interest rate.

10. ***The Phillips curve embodies the supply response of the economy and provides a measure of macroeconomic flexibility***. A forward-backward looking Phillips curve is used, which is broadly consistent with new-Keynesian models of inflation, and measures responses to supply shocks in terms of the degree of inflation inertia (measured by the coefficient 1-β) and response of inflation to deviations of output from potential output (γ). In such a model, a lower level of inflation inertia implies a measure of the flexibility of the economy, as it raises the speed at which the economy is able to absorb aggregate demand and supply disturbances, as discussed in more detail in Bayoumi and Sgherri (2004). By contrast, the relationship between the coefficient on the output gap and flexibility is ambiguous. While prices respond more rapidly in sectors of the economy that wish to attract resources, prices will also fall by more in sectors that should release them for the same reason.

11. ***Accordingly, estimated Phillips curves were used to measure Canada's flexibility compared to other major industrial countries over 1980-2003***. Equation (2) was estimated using generalized method of moments (GMM) with the first four lags of inflation, the output gap, and the interest rate as instruments. The sample included the G-7 countries and Australia, which, like Canada, is a sizeable industrial country relatively specialized in commodity production. All of the coefficients in Table 4 are correctly signed, and those on forward-looking inflation are consistently highly significant. The coefficients on the output gap are estimated with considerably less precision and are not discussed further.

Table 4. Phillips curve estimates 1/

$\pi_t = \beta\, \pi^e_{4,t+4} + (1-\beta)\, \pi_{4,t-1} + \gamma\, y_t + \varepsilon^{\pi}_t$

Country	Forward Looking Coefficient	Output Gap Coefficient	Adj. R^2
Canada	** 0.67	0.09	0.56
	(0.07)	(0.08)	
United States	** 0.60	* 0.19	0.50
	(0.06)	(0.09)	
Japan	** 0.85	* 0.31	0.19
	(0.15)	(0.14)	
Australia	** 0.61	* 0.22	0.59
	(0.09)	(0.11)	
Germany	** 0.54	0.14	0.30
	(0.15)	(0.16)	
France	** 0.56	0.03	0.82
	(0.07)	(0.08)	
Italy	** 0.52	* 0.18	0.92
	(0.06)	(0.08)	
United Kingdom	** 0.54	0.14	0.58
	(0.08)	(0.14)	

Source: Fund staff calculations.
1/ The coefficients are estimated over 1980:1−2003:4 using GMM with instruments being the first 4 lags of inflation, the output gap, and nominal interest rates. Robust standard errors are reported in parentheses. ** and * indicate the coefficient is significant at the 1 and 5 percent levels, respectively.

12. ***The results suggest that European countries (France, Germany, Italy, and the United Kingdom) all exhibit less flexibility than the non-European countries (Australia, Canada, Japan, and the United States)***. The average of the coefficient on forward-looking inflation (β) is 0.54 for European countries and 0.68 for non-European countries. The four European countries also have the lowest coefficient estimates in the sample, which is strong evidence that flexibility is lower in Europe, as such an outcome for these countries would occur by chance less than one percent of the time.

13. ***Canada's results are similar to most of the other non-European economies***. Canada's coefficient on forward-looking inflation is 0.67, slightly higher than those found for the United States and Australia, but, given the standard errors on the coefficient estimates, these differences could well reflect noise. The most surprising result given the earlier analysis is the extremely high coefficient on forward-looking inflation in Japan. This could well reflect the relatively flexible wage structure, where almost one-third of overall wages comprise annual bonuses that vary with the state of the economy. However, this flexibility has to be seen in the context of the "jobs-for-life" environment that limited real flexibility, helping to explain why Japan appears to be less flexible in the microeconomic analysis discussed in earlier sections.

14. ***IS curves were also estimated to examine whether there were any systemic differences in the response of aggregate demand, but no patterns were found***. The IS curve relates the current level of the output gap to its expected future and past values (with the coefficients constrained to sum to unity), as well as the level of real interest rates.[72] Estimated equations could reveal differences in flexibility—for example, using similar arguments to those used for the Phillips curve, more flexible economies might have lower coefficients on lagged output gap. However, the results (not shown) indicated remarkable stability in the coefficients across countries, with most estimates of the coefficient on the lagged output gap being close to one-half and real interest rate effects being small and insignificantly different across countries.

E. Conclusions

15. ***The results in the paper suggest that Canada has a relatively flexible economy compared with other major industrial countries, with the likely exception of the United States.*** This conclusion comes from measures of economic flexibility using a range of approaches, including the response of output at the sectoral level, microeconomic studies of firm behavior, and from macroeconomic relationships. It suggests that, while on a number of measures the flexibility of the Canadian economy is lower than that of its neighbor to the south, any gap is small, particularly when compared to other industrial countries.

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PART IV: FINANCIAL SECTOR ISSUES

VI. Large Banking Groups and Financial System Soundness[73]

A. Overview

1. ***This paper uses market-based soundness indicators to assess the stability implications of the rapid growth and shifting business strategies of Canada's large banking groups***. Helped by changes in the regulatory framework, a process of mergers and acquisitions has led to the emergence of six large banking groups (LBGs) that account for a large share of the Canadian financial system. Over the past twenty years, the LBGs have been diversifying income and balance sheets by reducing the share of traditional deposit and lending activities and taking on more exposure to domestic and international financial markets. The soundness measures presented in this paper—based on so-called "distance-to-default" models—suggest that the rapid growth of the LBGs in the second half of the 1990s was associated with a significant increase in their overall risk profile. More recently, however, LBGs' risk-adjusted returns appear to have improved, and soundness has been further underpinned by ongoing increases in capital adequacy ratios.

2. ***The recent strong performance of the LBGs speaks to a high degree of resilience of the Canadian financial system***. In 2001, financial market weakness following the demise of the high-tech stock market bubble and the global slowdown affected LBG performance. However, bank profitability has since recovered and other financial soundness indicators have continued to strengthen from already comfortable levels. Moreover, the relatively modest rise in default risk during the recent slowdown, compared with that during the Russian, Brazilian and LTCM crises of the late 1990s, suggests a strengthening of risk management practices on the part of the LBGs.

B. Banking Sector Trends

3. ***The Canadian banking sector is highly concentrated***. The six major LBGs account for around 90 percent of Canadian deposits and banking assets. Based on mid-2004 balance sheet data, the largest LBG accounts for almost 25 percent of total banking assets, followed by four institutions each holding close to 15 percent of total assets. The sixth LBG accounts for about 5 percent of total assets.

4. ***The LBGs went through a rapid growth spell in the second half of the 1990s, partly in response to recent legislative changes*** (Box 1). From end-1996 to end-2001, their deposit base and total assets expanded by more than 50 percent. On the asset side, investments were channeled in particular into securities and mortgages. In recent years, however, balance sheet expansion has slowed down dramatically, in part for cyclical reasons.

[73] Prepared by Gianni De Nicoló, Alexander Tieman, and Robert Corker, with research assistance from Marianne El-Khoury. All were in MFD at the time of writing.

Box 1. Changes to Canada's Financial Sector Legislation

The rapid growth of LBGs has been facilitated by changes to Canada's financial sector legislation:

- Amendments to the regulatory framework in 1987 and 1992 removed legal barriers separating the activities of various types of financial institutions, allowing Canadian financial institutions to develop into financial conglomerates (Freedman, 1998).
- In 2001, limitations on investment in non-financial business were also relaxed, together with the introduction of a holding company regime. At the same time, a new merger-review policy was introduced, mainly in response to the government's 1998 decision not to allow two mergers involving four of Canada's largest banks (Ministry of Finance, 1998; Group of Ten, 2001).
- The new policy raised the ownership limit to 20 percent for voting shares and 30 percent for non-voting shares, and loosened the requirement that large banks be widely held, while retaining the requirement that no investor hold a majority share in the bank (Daniel, 2002).

The Canadian regulatory and supervisory regime is subject to regular reviews in order to keep pace with the changing technological and market environment. Canada's financial legislation contains sunset clauses that prescribe periodic reassessments and updating of the regulatory framework that governs the financial system. In the past, the review used to take place once every ten years. In 1992, the review period was shortened to five years and extended to the legislation governing all federal financial institutions.

5. ***LBGs' investment behavior since the mid-1990s is the continuation of a longer trend reflecting the expansion of their fee-earning business***. As part of their growth and diversification strategy, LBGs have been acquiring mortgage loan companies, securities businesses, and trust companies (Calmès, 2004). Through this process, they have expanded their links to financial markets and, in particular, their exposure to equity markets. In mid-2004, securities accounted for 27 percent of total assets, compared with 19 percent at the end of 1996 (Table 1).[74]

6. ***The LBGs have also acquired substantial foreign investments***. Consistent with many analysts' view that the Canadian market does not offer sufficient banking economies of scale, LBGs have sought to expand their business abroad. Over the past 10 years, LBGs' foreign securities holdings have grown at roughly three times the pace of domestic securities. While accumulating large U.S. dollar exposures in general, LBGs have also acquired extensive direct investments in the United States and the Caribbean.

[74] This reflects an increase in the share of assets devoted to securities for all except one LBG.

Table 1: Balance Sheet Items of Six Large Banking Groups
(In percent, unless otherwise noted)

	Dec-96	Dec-00	Dec-01	Dec-02	Dec-03	Jun-04
Total assets						
In billions of C$	1,015	1,438	1,587	1,628	1,627	1,671
Annual percent change		9.1 3/	10.4	2.6	-0.1	2.7
As percent of GDP	121.3	133.5	143.2	140.6	133.5	129.4
Aggregate balance sheet shares						
Assets						
Securities	19.0	23.4	25.2	24.7	27.4	26.8
Non-mortgage loans	41.0	37.2	36.0	34.6	31.0	32.7
Mortgage loans	19.9	19.3	19.3	20.0	21.2	21.4
Other	20.1	20.1	19.5	20.7	20.4	19.1
Liabilities						
Deposits	68.2	67.6	66.6	66.1	65.8	67.1
Other	31.8	32.4	33.4	33.9	34.2	32.9
Net income before tax 1/	1.0	1.0	0.8	0.6	0.9	1.2
Net interest income/total net income	60.6	39.5	40.9	43.6	47.9	47.2
Capital adequacy ratio 2/	9.2	11.7	12.3	12.3	13.3	13.4

Source: Office of the Superintendent of Financial Institutions.
1/ As percent of total assets.
2/ In percent of risk-weighted assets.
3/ Average annual percentage change 1996–2000.

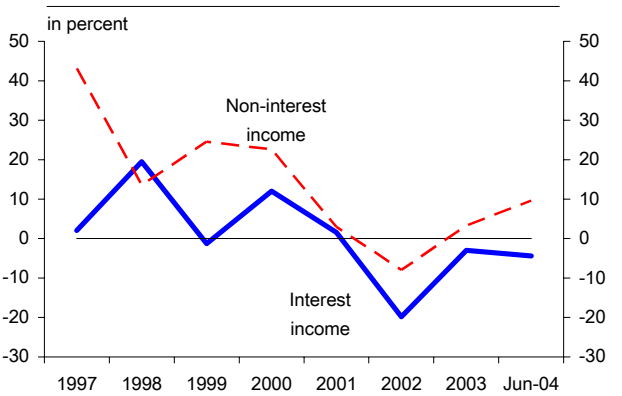
7. ***The counterpart to this portfolio shift has been a sharp decline in the relative importance of LBGs' traditional lending business, excluding mortgages***. Increases in non-mortgage lending have barely kept pace with inflation since the mid-1990s, notwithstanding rapid growth in LBGs' deposit base. This has only partly been offset by mortgage lending that has expanded in line with, or even faster than the total asset base. As a result, LBGs' net interest income now accounts for less than half of total net income compared with about 60 percent in the mid-1990s.

8. ***These trends and strategies of large banking groups are not unique to Canada***. Most of the large financial institutions in the United States and elsewhere have expanded their securities and mortgage business, and consequently derive a greater share of their income from fees and other non-interest sources (IMF, 2004).

9. ***Foreign and financial market exposures contributed to significant strains in the banking sector after the bursting of the stock market bubble***. Although the downturn of the Canadian economy was relatively mild, non-interest income growth dropped from over 25 percent per year between 1996 and 2000 to virtually zero between 2001 and 2003 (Figure 1). With impaired assets and loan loss provisions up sharply, return on equity for the banking system as a whole fell from 15.8 percent in 1999 to 9.4 percent in 2002, but has since rebounded (Table 2).

10. ***Nevertheless, throughout both the growth spell and subsequent slowdown, LBGs continued to build up capital relative to risk-weighted assets***. Total LBG capital increased by about 70 percent between 1996 and 2001, translating into a rise in the average capital ratio from 9.2 percent to 12.3 percent. Following a drop in both capital and risk-weighted assets in 2002, the average capital ratio increased to 13.3 percent in 2003, boosted by increases in capital and a further decline in risk-weighted assets. Throughout the period, all banks remained substantially above the minimum capital requirements set in the 1988 Basel capital accords.

Figure 1. Growth of income components of LBGs



Source: OSFI.

Table 2. Vulnerability Indicators of the Banking System 1/

	1997	1998	1999	2000	2001	2002	2003
Balance sheet							
Total loans to assets (percent)	62.8	58.4	58.7	57.7	55.8	55.6	53.8
Total loans to deposits (percent)	92.5	90.2	86.8	84.2	84.5	83.1	81.3
Impaired assets/total assets	0.68	0.66	0.59	0.60	0.84	0.90	0.64
Loan loss provision (in percent of total assets)	0.18	0.20	0.23	0.27	0.37	0.57	0.23
Total foreign currency assets/total assets 2/	41.5	46.4	40.2	40.5	42.7	41.4	36.2
Total foreign currency liabilities/total assets 2/	43.5	47.7	42.4	42.2	44.7	43.8	37.7
Total foreign currency deposits/total assets 2/	30.7	32.2	31.3	29.5	30.4	28.9	25.6
Profitability							
Return on total shareholders' equity (percent)	16.4	13.4	15.8	15.3	13.9	9.4	14.7
Return on average assets	0.71	0.57	0.71	0.72	0.66	0.44	0.69
Average intermediation spread	2.9	2.6	2.7	2.9	3.0	3.0	3.1
Net interest income (in percent of avg. total assets)	2.1	1.8	1.8	1.8	1.9	2.0	1.9

Sources: Bloomberg; Canadian Bankers Association; Haver Analytics; and Office of the Superintendent of Financial Institutions.
1/ Unless otherwise indicated, based on data reported by the six largest chartered Canadian banks, which account for some 90 percent of the total market share.
2/ All chartered banks.

11. ***LBGs have also reduced their off-balance sheet activities***. Prior to 1998, LBGs took on increasing exposures in the derivatives markets as well as boosting other off-balance sheet exposures. These were scaled back in subsequent years, following the Russia and Brazil crises and the LTCM collapse. With one exception, the LBGs have not expanded—and in some cases made further sizable contractions in—their off-balance sheet activity since 1999.

12. ***Despite similar features, the business strategies of the six LBGs have not been identical and financial performance has been varied***. The largest and one of the mid-tier

LBGs deviated from the other institutions in that they built up their securities portfolio share more rapidly and reduced their share of mortgage loans. The financial performance of these two institutions has been quite different. The largest bank appeared to weather the post-2000 slowdown relatively comfortably, whereas profitability in the other bank—which had the fastest growing balance sheet and the most rapid buildup of securities investments of all LBGs—was quite volatile, culminating in pre-tax losses in 2002. One other LBG—the one with the fastest growing exposure to the mortgage market—also saw its profits fall to a very low level in 2002, whereas the other three institutions experienced only mild dips in profitability.

C. Market-Based Financial Soundness Indicators

13. ***Business strategies of the LBGs affect both the financial soundness of the individual institutions and that of the financial system as a whole***. Increased diversification, both internationally and across different business lines, should in principle yield better risk profiles for financial institutions. But when diversification takes place at the expense of lower capital or profitability, or increased earnings volatility, financial soundness may not necessarily improve—as reflected in the recent performance of individual banks. Moreover, were all LBGs to diversify in the same direction, systemic vulnerability (i.e., the risk of several banks experiencing distress at the same time) to large, common shocks could increase even if each bank individually was better hedged against risks.

14. ***This section evaluates trends in Canada's financial system vulnerability using a market-based soundness indicator***. The indicator, which was estimated for the period 1991–2003, is based on distance-to-default (DD) models commonly used in the finance literature and increasingly reported in central bank financial stability reports. DD is a composite measure computed as the sum of the return on the estimated market value of assets and the capital-to-assets ratio at market prices, divided by the volatility of assets.[75] It thus combines measures of profitability, balance sheet strength, and market uncertainty. A higher DD indicates an improvement in financial soundness at the company level, for example because of improved profitability, a higher capital ratio, or reduced volatility—or a combination of all three.[76] Although DD measures are sensitive to variations in the underlying assumptions,

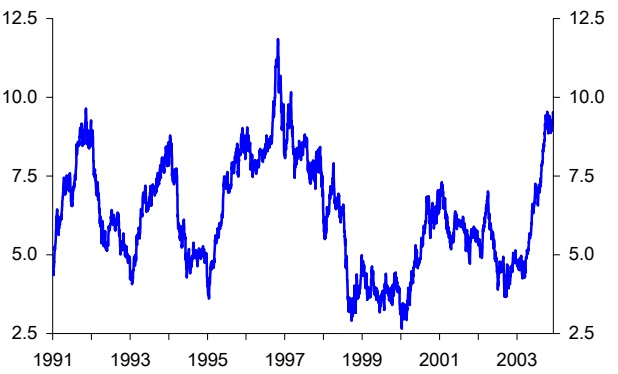
[75] Estimates of the market value of assets are based on the structural valuation model of Black and Scholes (1973) and Merton (1974), and were computed using the estimation procedure described in Vassalou and Xing (2004) using daily market and annual accounting data.

[76] Two caveats apply. First, the DD as employed in this paper does not take into account the stochastic interest rate risk stemming from the correlation between the risk-free rate and the value of a company's assets. As this is potentially another important source of risk banks face, risks might be underestimated in the analysis. See Liu, Papakirykos, and Yuan (2004) for an extension incorporating interest rate risk. Second, as the DD is based on market data, the DDs for LBGs can be subject to large fluctuations, which tend to be associated with the business cycle and 'expectation cycles' regarding future earnings prospects.

they have been shown to predict supervisory ratings, bond spreads, and rating agencies' downgrades.[77]

15. ***The analysis provides a number of conclusions regarding the impact of evolving business strategies on LBGs' financial soundness***:

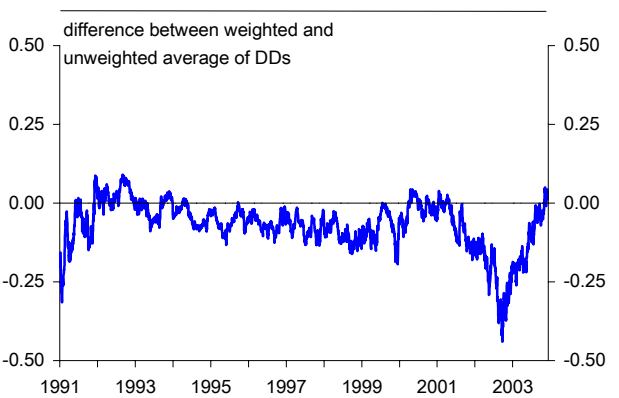
Figure 2. Average Distance to Default of LBGs



Source: Fund staff calculations.

- ***There appears to be no trend movement in the average DD for the six LBGs since 1990*** (Figure 2). Although distance to default narrowed sharply in the late 1990s as a substantial deterioration in the risk-adjusted return outweighed rising capital ratios, the LBGs' average risk profile has again improved significantly in the last few years. Overall, this suggests that shifting business strategies and changing balance sheet structures have not led to a noticeable increase or decrease in average default probabilities for the LBGs.

Figure 3. Risk Concentration in LBGs



Source: Fund staff calculations.

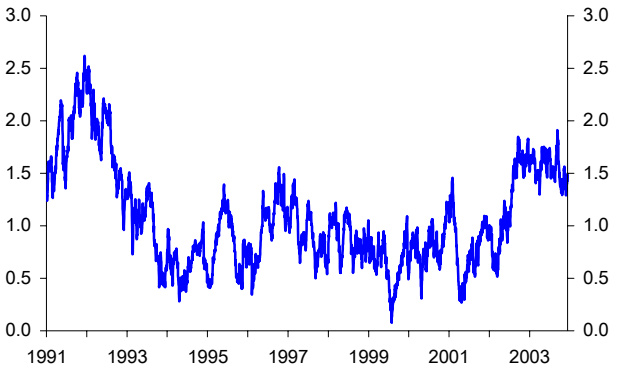
- ***With one notable exception, there has been no tendency for risk to concentrate in the largest banks***. Risk concentration can be measured as the difference between the weighted and unweighted average of DDs over all six institutions, with weights given by each LBG's share of total market valuation. A decline in this measure indicates a concentration of risk in the largest banks, and vice versa. For most of the period observed, this measure of concentration was unchanged (Figure 3). However, it dropped in 2002, owing to a substantial reduction in the market valuation of two of the largest LBGs.[78] The spike highlighted risks in two of Canada's important banks, even though average soundness measures for the sector remained satisfactory.

[77] See Krainer and Lopez (2001), Gropp, Vesala, and Vulpes (2002), and Chan-Lau, Jobert, and Kong (2004).

[78] If balance sheet valuations of assets are used to weight the DDs, the downward spike largely disappears. However, the use of market valuations seems preferable for diagnostic purposes as the objective is to capture the market's assessment of risk.

- ***Risk profiles of the LBGs do not appear to have converged***. The standard deviation of DD indicators for the six individual LBGs does not exhibit a trend over the past 15 years (Figure 4). In fact, a rising standard deviation suggests that banks' risk profiles have diverged somewhat in the last few years.

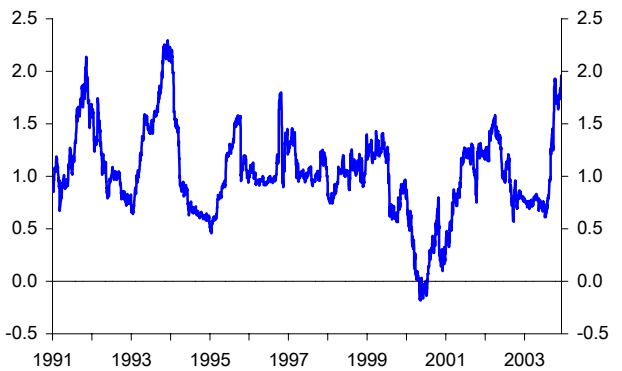
Figure 4. Standard Deviation of Distance to Default of LBGs



Source: Fund staff calculations.

- ***LBGs appear resilient to common shocks***. A "system" DD can be computed using market measures of return and volatility for the aggregate LBG subsector and its capital-asset ratio. As such, it measures the default risk of an entity whose balance sheet is the aggregate of the LBGs' balance sheets. The system DD is almost always substantially higher than the average DD, indicating that correlations between the portfolios of the different LBGs are low, and hence that the group of LBGs as a whole remains well diversified (Figure 5). The exception was around 2000, when a relatively high correlation among individual DD measures—reflecting the broad-based decline in equity prices—implied that the system as a whole fared no better than individual LBGs. However, the difference between the system and average DD has since rebounded to above its long-term average.

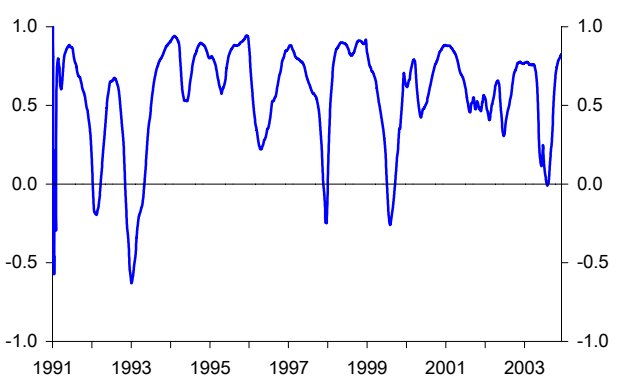
Figure 5. System DD minus Average DD of LBGs



Source: Fund staff calculations.

- ***However, high correlation of DD measures across sectors suggests the broader financial system typically has a high degree of common risk exposure***. In particular, the correlation between system DDs of the banking and insurance sectors is mostly around unity, suggesting that risks across

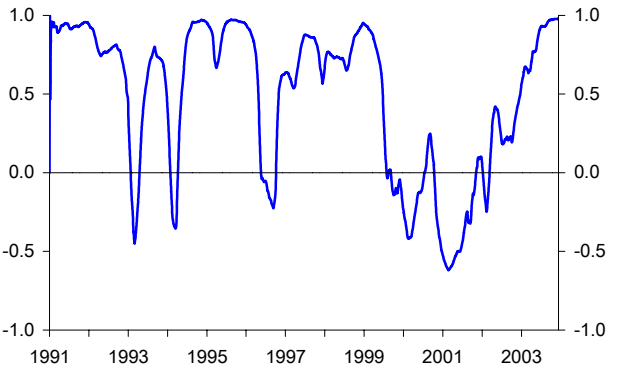
Figure 6. Correlation between Banking and Insurance Sector DDs



Source: Fund staff calculations.

the financial sector are closely aligned (Figure 6).[79] In effect, most of the time, the fortunes of the LBGs and other financial institutions are expected to follow similar paths. Risks in the banking sector and the non-financial sector also tend to be positively correlated—with the notable exception of the period between 1999 and 2001 when market sentiment turned against financial institutions well ahead of the general fall in the stock market (Figure 7).

Figure 7. Correlation between Banking and Non-Financial Sector DDs



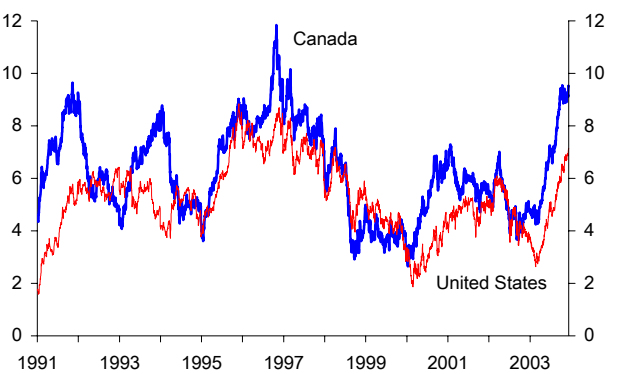
Source: Fund staff calculations.

16. ***The relatively strong performance of financial soundness indicators for Canadian LBGs in recent years likely reflects improvements in risk management***. Perhaps surprisingly at first sight, given LBGs' increased exposure to stock markets, the deterioration of DD indicators after 2000 was relatively modest. In particular, the decline in the average DD—signaling a rise in vulnerability—was much less than the drop following the Russia default, Brazil crisis and LTCM collapse in 1998 and 1999 when market volatility of bank valuations increased substantially. This observation is consistent with anecdotal evidence that Canadian LBGs, like other large and internationally active banks, have improved their risk management capabilities in recent years, strengthening their ability to absorb the impact of shocks on their balance sheets (e.g., Bank of International Settlements, 2002).

D. Soundness Indicators in Canada and the United States

17. ***The broad trends in financial soundness indicators in Canada have much in common with those in the United States***. Large banking groups in both countries have undergone rapid growth and similar structural shifts in their balance sheets. During the second half of the 1990s, this expansion was accompanied by almost identical declines in average DD measures for U.S. and Canadian large banking groups (Figure 8).[80] Since the beginning of the

Figure 8. Average DD in Canada and the United States



Source: Fund staff calculations.

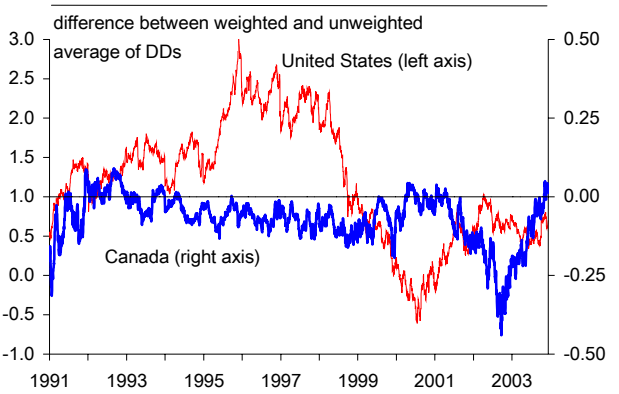
[79] Correlations are computed using daily data and a one-year rolling window.

[80] For more analysis of distance-to-default measures in the United States, see IMF (2004).

current decade, DDs in both countries have been volatile, although on average have increased by a greater amount in the Canadian case—which may reflect a somewhat stronger build-up of capital ratios. Nonetheless, differences between the two countries are small, and LBGs in both countries have come through the recent testing period of economic downturn and financial market distress with strengthened soundness indicators.

18. ***In contrast to the United States, structural change does not appear to have led to an increase in risk concentration in the Canadian banking system***. In Canada, the risk concentration measure (weighted minus unweighted average DD) has been relatively unchanged since the beginning of the 1990s (Figure 9). In essence, the Canadian system has remained dominated by the same number of broadly equal-sized players with relatively independent risk profiles. By contrast, risk concentration in the United States increased markedly in the second half of the 1990s, owing in part to consolidation—on the same scale, the temporary increase in risk concentration in the Canadian system in 2002 noted above is much smaller.

Figure 9. Risk Concentration in Canada and the United States



Source: Fund staff calculations.

E. Summary

19. ***This paper suggests that substantial growth and structural change in the Canadian banking sector have not, over time, added to systemic risk***. Default risk did rise significantly when balance sheets expanded rapidly in the second half of the 1990s. However, helped by the ongoing buildup of additional capital and seemingly improved risk management practices, risk profiles have subsequently recovered. Moreover, LBGs' individual risk profiles have remained relatively uncorrelated, notwithstanding their business strategies sharing many common features, and risk concentration has not on average increased. However, with a relatively small number of players, each individual LBG is of systemic consequence. A close correlation of risk profiles between banks and insurance companies implies that the financial sector as a whole remains exposed to common sources of risks.

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VII. COMPETITION IN CANADA'S BANKING SYSTEM[81]

A. Introduction

1. ***With bank merger guidelines currently under review by the government, discussion on the merits of allowing mergers between large financial institutions continues***. Some analysts have argued that a lack of mergers may constrain banks' ability to compete internationally, given the comparatively small size of the Canadian market.[82] Other commentators have cautioned that mergers would increase the already high concentration in Canada's banking sector, adversely affecting competition and thus consumer interests.[83] Some observers are particularly concerned about the prospect of mergers among the six largest banks, which account for about 90 percent of all banking assets.

2. ***This paper uses an Industrial Organization (IO) approach to measure the degree of competition among the largest Canadian banks compared with other countries***. In particular, it analyzes competition in banking systems with a larger number of banks than in Canada, such as the United States, which has a large and fragmented banking system; the United Kingdom, which has fewer banks; and continental Europe.

B. Optimal Level of Bank Competition: A Review of the Literature

3. ***The literature is inconclusive on the relative merits of a highly competitive banking system versus a structure that retains some degree of monopolistic power***.[84] This applies to the literature studying the consequences of competitive structures for allocative efficiency and productivity, as well as to work looking into the effects on banking system stability. Theoretical results largely depend on which particular model is chosen, and empirical approaches have also failed to support any firm conclusion.

4. ***Standard IO methods applied to the banking industry suggest that perfect competition achieves allocation efficiency by channeling credit to its most productive use***. However, other theoretical approaches that take into account some specific aspects of the banking business—such the presence of information asymmetry and the effect of a bank's net worth on the quantity of credit supplied—suggest that a banking system with some market power may provide more and higher quality credit. This result rests on the argument that banks with some monopoly power are more prepared to engage in costly activities that

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[81] Prepared by Iryna Ivaschenko. This paper benefited from comments provided by the Bank of Canada and the Department of Finance.

[82] In an interview on September 3, 2004, Industry Minister Emerson said that Canadian banks risk becoming low level players on global lending markets if Ottawa does not allow them to merge. See also Bond (2003).

[83] For example, a majority of respondents to a recent survey conducted among members of the Canadian Federation of Independent Business and other small and medium-sized enterprises agreed that competition in the financial services sector should increase before additional bank mergers were approved.

[84] See Northcott (2004) for a comprehensive review of the literature.

mitigate information asymmetries, such as relationship lending and screening (Petersen and Rajan, 1995; Cetorelli and Peretto, 2000).[85] Empirical studies have also failed to find convincing evidence that market power is detrimental to credit allocation (Northcott, 2004, and references therein). Earlier studies found a negative relationship between the degree of competition and bank profits, but the results were not robust across time, products, or profit specification. More recent research has found that this relationship is weakened or eliminated if differences in banks' productive efficiency is taken into account (see Berger, 1995 and Punt and Rooij, 2001).

5. ***Standard IO methods also suggest that perfect competition achieves productive efficiency since it maximizes the quantity of credit supplied at the lowest interest rate***. However, the results are not clear-cut once economies of scale—which usually exist in banking—are taken into account. Berger and Mester (1997) review studies that found some empirical evidence pointing at inefficiencies in banking, but it is not clear whether these arise from a lack of competition or unrealized scale economies.

6. ***There is no consensus in the literature on which market structure may promote prudent behavior, which would benefit the stability of the financial system***. Some studies have suggested that market power may encourage prudent risk-taking and screening of borrowers, improving loan quality (Keeley, 1990; Salas and Saurina, 2003). However, other research found that strong regulations and disclosure requirements can mitigate risk-taking and promote screening regardless of the competitive environment (Cordella and Yeyati, 2002).

C. Methodology and Data

7. ***This paper uses a standard IO approach to assess the competitiveness of large Canadian banking groups***. The Panzar-Rosse approach measures market power by the extent to which changes in factor prices are reflected in revenues. Under perfect competition, an increase in factor prices induces a proportional change in revenues since firms face perfectly elastic demand for their products. Conversely, under monopolistic competition, revenues change less than proportionally in response to changes in factor prices. In the case of a perfect monopoly, there may be no response or even a negative response of revenues to changes in input costs. To measure the degree of competition in a particular market, Panzar and Rosse (1987) proposed the so-called H-statistic, which is computed as the sum of elasticities of revenues to unit factor costs in a reduced form revenue equation.

8. ***This approach has recently been applied to banking systems in a number of countries***. Although not initially intended to be applied to the financial system, Panzar and Rosse's original methodology has since been adapted to investigate the competitive structure

[85] In addition, Petersen and Rajan (1995) using U.S. data also found that supply of credit to young firms is greater in the system with market power, which should encourage innovation and productivity growth.

of banks.[86] Applications in the literature include the cases of Germany and several European countries (De Bandt and Davis, 2000; IMF, 2003), the United States (Shaffer, 1982); and Canada (Nathan and Neave, 1989). Canada's broad financial system was found not to exhibit monopoly power at the time, but the consolidation that has taken place in recent years suggests a need to revisit this result.

9. ***Following the approach of Nathan and Neave (1989), the following base model was estimated***:

$$\log INCNET = \text{constant} + \alpha \log PFUND + \beta \log PCAP + \lambda \log PLAB + \delta \log AAST \quad (1)$$

where *INCNET* is net income, *PFUND* the unit price of funds, *PLAB* the unit price of labor, *PCAP* the unit price of capital, and *ASST* represents total assets. Total assets are included to identify possible scale economies, given the wide range of asset sizes across countries. For this model, $H = \alpha + \beta + \lambda$. In perfect competition case H=1. A positive value of H, which is below unity, indicates monopolistic competition, with higher values of H corresponding to a more competitive industry. Negative values of H could indicate either that the banking system is perfectly monopolistic or that the market is not in equilibrium (e.g., because of structural change), in which case the H-statistic could not be applied.[87]

10. ***The paper uses annual BankScope data for the largest banks in Canada, the United States, Germany, France, Italy, and the United Kingdom from 1999 to 2003***. The unit price of funds was calculated as interest expenses over total deposits, the unit price of labor as personnel expenses over total liabilities, and the unit price of capital as other expenses divided by total liabilities.[88] The sample contains 35 banks in Canada, 27 of the largest U.S. banks, 290 French banks, 266 German banks, 127 Italian banks, and 200 banks in the United Kingdom.

D. Results

11. ***The empirical evidence supports the view that Canadian banks have grown more slowly than major foreign competitors*** (Table 1). Although the Canadian Big Six have

[86] The extension of the Panzar-Rosse methodology to banking requires banks to be treated as single-product firms, consistent with the intermediation approach to banking in which banks are viewed as financial intermediatries (see Colwell and Davis, 1992, for details).

[87] Panzar and Rosse's (1987) model is based on the premise that the competitive structures under analysis are in a long-term equilibrium. Adjustments to shocks or structural change could affect the way changes in factor prices translate into revenue changes, rendering the H-statistic less useful.

[88] The cost per square foot of premises would be a better measure of the cost of physical capital, but this data is not currently available.

maintained profit growth, they have lagged their U.S. counterparts in both profitability and, particularly, balance sheet growth. The average size of the Big Six was comparable to banks in the United States and the United Kingdom in 1999. By 2003, however, large Canadian banks were on average 12 percent smaller than U.S. banks, and more than 60 percent smaller than banks in the United Kingdom.

Table 1. Size and Profitability Indicators of 25 Largest Banks

Country	Total Assets 1/ (billion US$)	Return on Assets*	Return on Equity*
1999			
Canada	37.4	0.6	8.6
Big Six	137.0	0.8	15.9
France	113.0	0.5	2.5
Germany	75.7	0.2	5.0
Italy	55.9	0.9	10.8
Spain	29.8	1.0	11.0
United Kingdom	151.0	0.8	18.2
United States	143.0	1.6	18.1
2003			
Canada	52.4	0.8	9.4
Big Six	195.0	0.8	14.7
France	154.0	0.3	4.3
Germany	140.0	0.1	1.9
Italy	68.5	0.3	6.0
Spain	45.8	0.9	10.0
United Kingdom	325.0	0.6	12.3
United States	217.0	1.6	16.7

Source: BankScope.
1/ Unweighted average.

12. ***The Panzar-Rosse competitiveness measure provides a mixed assessment of the competitiveness of the Canadian banking system.*** The statistic was calculated for all banks in the sample, based on a fixed effect panel estimation.[89] The results indicate that the banking system in Canada is slightly more competitive than those in continental Europe, the United Kingdom, and the 27 largest national banks in the United States (Table 2). At the same time, the H-statistics for the Big Six banks is negative, which could suggest the presence of some monopolistic power. Canada is clearly not a case with large banks operating as a perfect monopoly, given that the H-statistic is not significantly different from zero, but alternative tests confirm that the Panzar-Rosse statistic is valid and not tainted by structural change.[90]

13. ***The analysis indicates that Canada is not the only country where large banks seem to enjoy some pricing power***. The level of competition among large institutions in other countries varies considerably and—as in Canada—differs from the competitiveness measure of the broader system for some countries. For example, when comparing the 25 largest banks by asset value across countries, the results suggest that only U.K. and Spanish large banks operate in a fully competitive environment (Table 3). All other countries are similar to Canada in that large banks enjoy some degree of monopolistic power.

[89] The fixed effect approach was suggested by a Hausman test.

[90] As discussed above, the negative value of the H-statistic could also indicate that the Canadian banking system goes through a period of structural change, in which case the Panzar-Rosse approach would not be valid. However, Shaffer (1982) argued that the return on assets or on equity (ROA/ROE) should not be correlated with input prices in the absence of structural change. Therefore, equation (1) was re-estimated with log ROA on the left hand side. The hypothesis H=0 could not be rejected, suggesting that the Panzar-Rosse statistic is valid in Canada's case.

Table 2. H-statistics, by Country and Region

Region	H-statistics 1/	Standard error	p-value
All countries	** 0.509	0.084	0.000
United States 2/	0.283	0.182	0.119
United Kingdom	** 0.581	0.087	0.000
Continental Europe	** 0.321	0.192	0.095
France	1.150	4.200	0.784
Germany	** 0.482	0.134	0.000
Italy	** 0.471	0.127	0.000
Spain	** 0.283	0.122	0.020
Canada, all banks	** 0.698	0.178	0.000
Canada, Big Six 3/	-0.389	0.391	0.319

Source: Fund staff calculations.
1/ Asterisks signify that coefficients are significant at 5 percent level
2/ Only the 27 largest, national banks are included.
3/ The Big Six banks include CIBC, Bank of Montreal, National Bank of Canada, Toronto Dominion, Royal Bank of Canada, and Scotiabank.

Table 3. H-statistics for 25 Largest Banks, by Country and Region

Region	H-statistics 1/	Standard error	p-value
All countries	** 0.467	0.120	0.000
United States	0.259	0.191	0.175
United Kingdom	** 0.705	0.134	0.000
Continental Europe	** 0.436	0.204	0.033
France	0.185	0.282	0.512
Germany	0.337	0.530	0.524
Italy	0.385	0.406	0.343
Spain	** 0.292	0.126	0.021
Canada	0.082	0.500	0.870
Canada, Big Six	-0.389	0.391	0.319

Source: Fund staff calculations.
1/ Asterisks signify that coefficients are significant at 5 percent level.

14. ***The results also reveal that the number of large banks in a country is not as important for the level of competition as their combined market share***. For example, the Panzar-Rosse measure calculated for banks that hold 95 percent of a country's total consolidated bank assets—equal to the market share of the Canadian Big Six—again suggests that banking systems in the United Kingdom and Spain are particularly exposed to

competition (Table 4, upper panel).[91] However, competition increases across countries if the analysis is limited to banks that only account for 90 percent of total assets (Table 4, lower panel). At the same time, the number of banks accounting for a given level of bank assets varies greatly across countries and is not correlated with the Panzar-Rosse statistic (Table 5).

Table 4. H-statistics for Largest Banks, by Country and Region

Region	H-statistics 1/	Standard error	p-value
Panel A. Banks accounting for 95 percent of total consolidated assets			
All countries	0.180	0.112	0.108
United States	0.261	0.185	0.158
United Kingdom	** 0.528	0.166	0.001
France	0.629	0.385	0.102
Germany	-0.947	2.036	0.642
Italy	0.025	0.170	0.884
Spain	** 0.421	0.157	0.007
Canada	-0.389	0.391	0.319
Panel B. Banks accounting for 90 percent of total non-consolidated assets			
All countries	** 0.416	0.123	0.001
United States	0.261	0.185	0.158
United Kingdom	** 0.509	0.145	0.000
France	** 0.584	0.286	0.041
Germany	-0.021	0.609	0.972
Italy	0.295	0.389	0.447
Spain	** 0.520	0.157	0.001
Canada	-0.249	0.531	0.639

Source: Fund staff calculations.

1/ Asterisks signify that coefficients are significant at 5 percent level. Specification includes total assets.

[91] For Canada, the market share of the Big Six only takes into account domestic banking assets, excluding foreign subsidiaries and credit unions.

Table 5. Size and Concentration of Banking Systems Across Regions, 2003

	Size (billion US$)	Number of banks holding 95 percent of assets (consolidated)	Number of banks holding 90 percent of assets (non-consolidated)
Canada	1,274	6	6
France	3,764	12	17
Germany	2,264	4	14
Italy	2,783	87	22
Spain	1,493	15	11
United Kingdom	7,226	12	17
United States 1/	7,809	25	25

Sources: Statistics Canada; United States Federal Reserve; Primark DataStream; and BankScope.
1/ National commercial banks only, accounting for 70 percent of consolidated assets.

E. Conclusions

15. ***This paper analyzes the level of competition in the Canadian banking system, with a particular focus on the six large banks, and compares it with banks in other industrial countries***. Using an approach from the Industrial Organization literature, the paper does not reject the hypothesis that the Canadian Big Six may enjoy some degree of market power, although the broad banking system in Canada is found to be strongly competitive. The analysis of other countries reveals similar differences between large banks and the total banking system, with the United Kingdom and Spain the only countries where large banks appear to operate in a fully competitive environment. The paper also finds that the number of large banks in a country is not as important for the level of competition as their combined market share.

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