On the Feasibility of Monetary Union: Does It Make Sense to Look for Shocks Symmetry across Countries When None of the Countries Constitutes an Optimum Currency Area?

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On the Feasibility of Monetary Union: Does It Make Sense to Look for Shocks Symmetry across Countries When None of the Countries Constitutes an Optimum Currency Area?*

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Abstract

Usually, a monetary union is not considered feasible between countries if the correlations of shocks are positive but weak. This may not be so if the country with the larger output gap converges to full-employment equilibrium faster than the country with the smaller gap. We argue that common monetary policy can be destabilizing when countries' responses to non-monetary shocks are perfectly symmetric with a correlation of 1 but exhibit differing investment sensitivities to the real interest rate. We use Canada, Mexico and the United States to test the feasibility of a monetary union by documenting whether: 1) gross investments in Canada and Mexico are equally responsive to the real fund rate, and 2) Canada's and Mexico's output growth and inflation respond differently to US monetary policy shocks and oil price shocks. This approach implicitly dictates whether the shocks themselves are symmetric or asymmetric. Using quarterly data and SVAR methodology, we conducted two layers of analysis. We estimated SVARs for the periods 1970–2008, 1970–1990 and 1991–2008 to find that a monetary union is feasible between Canada and the US for the first two sample periods. For Canada and Mexico, we find similar responses of output growth to US monetary policy shocks. We conducted further robustness tests by estimating two identified VARs with common US variables and oil prices for Canada and Mexico to assess commonality in responses to shocks with the US. These results affirm that a monetary union is also feasible between Canada and the US.

JEL Codes: C32, F33, F42

Keywords: North American Monetary Union, US monetary policy shock, SVAR.

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Introduction

The purpose of this paper is to offer an alternative to the conventional wisdom of testing for shock symmetry to determine countries' suitability for monetary union. We propose an approach that focuses instead on the strength and commonality of the responses of the countries to monetary policy shocks of the potential anchor country. We use Canada, Mexico and the United States (US), members of the North American Free Trade Agreement (NAFTA), as a springboard to underscore the merits of this approach.

We examine how Canada and Mexico react to monetary policy shocks arising from the US and whether their responses differ to the US own output and inflation responses. The examination of the symmetry of shocks is of particular importance in the consideration of a North American Monetary Union (NAMU), as such an endeavor would require Mexico and Canada to secede control of monetary policy to the US due to the sheer size of the US economy relative to Canada and Mexico combined. The transition costs would be less severe if Canada and Mexico already react substantially and similarly to a US monetary policy shock.

Following the seminal work by Mundell (1961) on optimum currency area (OCA) and subsequent works by McKinnon (1963), Kenen (1969), and Tower and Willet (1976), the suitability of fixed, flexible exchange rate regimes and prospective monetary unions has been assessed based on the importance of relative economic sizes, labor mobility, degree of openness, trade concentration, and similarity of shocks. The determination of the degree of symmetry between shocks across countries has been thus far the most popular criterion used in empirical works to evaluate OCAs. According to this approach, one needs to test whether aggregate demand (AD) and aggregate supply (AS) shocks are positively and significantly correlated across member countries to conclude whether a monetary union is feasible or not, *ceteris paribus*.

Another strand of the literature concentrates on the differential impacts of monetary policy across industries, regions, consumer groups, and the size of firms within and across countries. This strand includes the works of Gertler and Gilchrist (1993, 1994), Oliner and Rudebusch (1996), Britton and Whitley (1997), Carlino and Defina (1998, 1999), Dornbusch *et al*. (1998), Ramos *et al*. (2003), and Clausen and Hayo (2006). All these studies have found differential responses, whether the study concentrated on is for the European Union or the United States. There have been some attempts in Canada to quantify the impacts of a common monetary policy. The initial contribution was made by Beare (1976), who documented the differential effects of money supply shocks on the Prairie Provinces for the period 1956–1971. The most serious piece of work since then was the recent contribution of Georgopoulos (2009), which provided further evidence that common monetary policy in Canada does impose serious costs on provinces that do not move along the same wavelength. In fact, Georgopoulos measured the differential regional effects of monetary policy shocks in Canada and found that primary industry-based provinces are more strongly and adversely affected by a contractionary monetary policy shock than a manufacturing-based province such as Ontario. Although Georgopoulos inferred that differential effects would surely occur across countries within the postulated NAMU, no formal study at the macroeconomic level has looked into the synchronicity of responses of Canada and Mexico to US monetary policy. Our paper therefore intends to fill that void.

In this paper, we take a slightly different, yet innovative, approach by investigating whether the responses of the two smaller NAFTA member countries to monetary policy shocks from the US are synchronized and whether these responses are similar to US own output and inflation responses to determine whether a North American monetary union is feasible.

Since Mexico and Canada are small open economies, our paper used a non-recursive approach by restricting the impact of Canadian and Mexican variables on the US interest rate in order to just-identify the vector autoregression (VAR). Simply put, we used the following ordering: fund rate, output and then inflation. This paper reports the response of Canada, Mexico and US output growth and inflation to a structurally identified US monetary policy shock, and calculates the correlation of the impulse responses. Prior to the VAR analysis, we investigated whether gross investments in Canada and Mexico exhibited differing degrees of sensitivity to US real fund rate. We conducted further robustness tests by estimating a pair of identified octavariate VARs with common US variables (output growth/output gap, inflation, nominal fund rate) and oil prices for Canada and Mexico to thoroughly assess their commonality in responses to shocks with the US.

The results of our paper suggest that the adjustment costs of a NAMU would be much less for Canada than for Mexico. From the perspective of Canada and US output and inflation impulse responses, our research lends support to the view that Canada is suitable for a NAMU for the overall and pre-targeting sample periods. This is due to the strongly symmetric output growth and inflation impulse responses of Canada and the US to oil price shocks and to a one standard deviation structural monetary policy shock in the US. In contrast, Mexico and the US have asynchronous impulse response correlations. Despite these robust results, the post-inflation targeting samples exhibit minimal impulse response correlations for the trivariate VARs and therefore does not lend support to a NAMU. Overall, though; our paper indicates that a monetary union would be more suitable for Canada than it would be for Mexico.

The rest of this paper is organized as follows: Section 2 explains the conceptual framework. Section 3 discusses the related literature. Section 4 describes the underlying theory and structural vector autoregression (SVAR) methodology. Section 5 describes and analyzes the characteristics of the data. Section 6 discusses the empirical results and Section 7 concludes the paper.

Section 2 The Conceptual Framework

There are at least two reasons for focusing on monetary policy shock responses rather than the correlation of AD and AS shocks. First, the literature has confirmed what is already known: even if every country in isolation constitutes a *de jure* monetary union, regions do differ, since resources are not evenly distributed, whether initially allocated by Mother Nature or by economic agents thereafter. There is no reason to expect economic agents to exhibit similar tastes and preferences or to make similar decisions when faced with opportunities and adversities. Neither can we expect a natural disaster to have the same impact on two different regions at all times. Therefore the requirement that AD and AS shocks be symmetric across countries for a currency union to be feasible, *ceteris paribus*, is too ambitious and unrealistic, most notably when symmetry refers to a situation where “regions experience similar shocks or similar magnitudes of change from a given shock” (Georgopoulos (2009); p. 2094).

What anchors common currency regimes when asymmetries are present across regions? It is believed that fiscal federalism schemes of income redistribution and market mechanisms (both capital and credit) act as insurance against bad economic times. Following Mundell's contributions (1973a, b), this strand of the literature has received its impetus, notably with the framework developed by Asdrubali *et al.* (1996) and earlier contributions by Atkeson and Bayoumi (1993), and Bayoumi and Masson (1995) among others are well noted. The results that emerge from the risk-sharing literature show that there is a sizable portion of shocks that remain unsmoothed after isolating the contributions of the different smoothing channels. For example, Asdrubali *et al*. report 25% for the US states, and Antia *et al.* (1999) and Balli *et al.* (2009) report 14% and 19% for Canadian provinces respectively. These findings reinforce the view that perfect correlation of shocks across/within regions or countries carries little probability of occurrence.

Assuming perfectly correlated shocks are unlikely, it is possible for common monetary policy to be destabilizing even when the regions or countries move in the same direction. This brings us to our second motivation for this paper. Our contention is that when it boils down to assessing the feasibility of monetary union on the basis of the synchronization of AD and AS shocks, a common response to monetary policy, both in direction and in magnitude, will be effective if there is perfect correlation. If the correlation is imperfect, then we need interest rate sensitivities to differ across countries, since the interest rate cannot be adjusted to suit both region-specific problems. For example, the Bank of Canada cannot set one interest rate for Central Canada and another interest rate for the Maritime Provinces. The magnitude is fixed for all, regardless of their differences. If interest sensitivities are similar and the AD and AS shocks are not perfectly correlated, the country with the lowest output gap might find itself forced into recession (inflationary mode) while the country with the highest output gap would converge toward full employment. This is exactly what we portray in Figure 1. We assume that Canada and Mexico start out with some kind of full employment level, Y_p, which does not have to be the same for both, and experience similar AD shocks in nature (changes in tastes and preferences, changes in government spending, etc.). If there is monetary union and the US sets the interest rate, provided that there is a difference in the output gaps, convergence to full employment equilibrium is not guaranteed for Mexico as long as investment is as sensitive to the real interest rate as it is in Canada. Mexico's economy could eventually find itself below equilibrium.

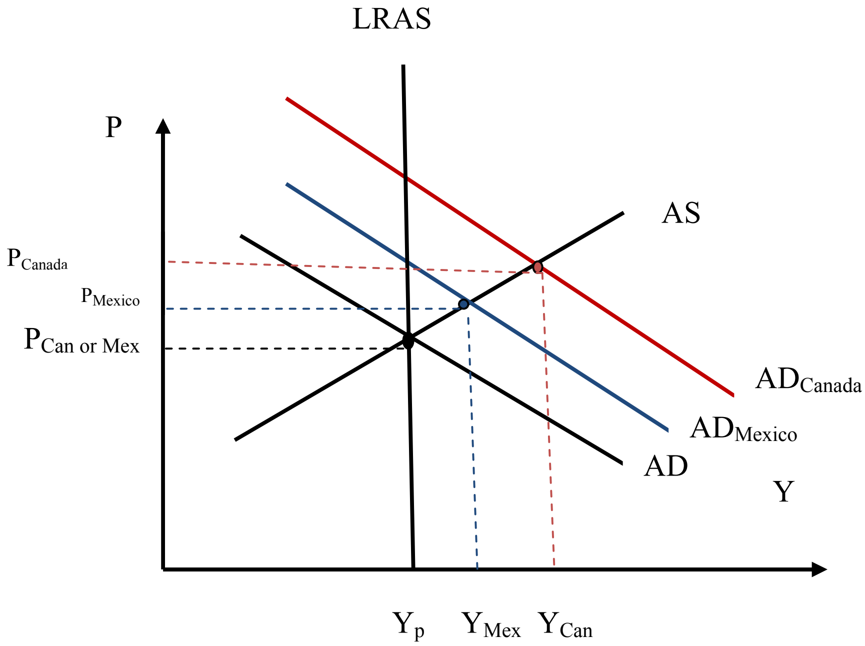

Figure 1

We can draw on practices in the medical field as an analogy to further clarify this line of reasoning. If two individuals suffer from the same disease, is it wise for the doctor to administer the same medication to both? Possibly, the answer is yes. The doctor has first to consider the medical history of each patient to determine whether they require the same drug and what dosage is appropriate. However, if a doctor conducting a controlled group experiment administered similar doses of the same medication to two sick individuals, without knowing the specifics of their diseases, but later discovered that both were cured, it can be inferred that the two subjects suffered from the same disease and have a similar medical history, or else that the medication can cure multiple diseases. The two individuals can be substituted for two economies, the "disease" is the non-monetary AD and/or AS shocks, and the "drug" is the common monetary policy. The only major difference is that the dosage of the medication can be adjusted to patients with different needs but the magnitude of the interest rate cannot fulfill the same purpose for two countries or regions. Many readers may question this analogy, but the economy is at least as complex as the human body. Therefore, testing for common responses of Canada and Mexico to US monetary policy is a stronger test of monetary union feasibility for the NAFTA member countries. First, it automatically dictates whether the shocks are symmetric or not across countries without having to extract those shocks. Second, it is less susceptible to spurious correlation since the focus is on the common response, or lack thereof, to the same variable. Lastly, it provides a more solid ground for negotiation on fiscal arrangements, and labor and capital mobility, should the decision come to forming a monetary union. What is appealing with this approach is that it shows there is still a pressing need to reflect on these mechanisms even when the shocks happen to be symmetric but their magnitudes differ across member countries.

To the best of our knowledge, there has been no paper that argues monetary policy can be destabilizing even when shocks are symmetric across countries, hence the need to focus on commonality of responses to monetary policy shocks and the relative sensitivity of investment to real interest rate across countries in assessing the feasibility of a monetary union.[2] Jean Louis et al. (2010a, b) did explore the commonality of Gulf Cooperation Council (GCC) member countries responses to US monetary policy shocks in assessing the role of the US Dollar as a suitable anchor for the proposed GCC currency, but they did not stress out the role that differing investment sensitivities to US monetary policy shocks can have across member countries.

Section 3: Related Literature

Since the end of the Bretton Woods system, Canada has had a freely floating currency, while Mexico has tried several exchange rate regimes, including adjustable and crawling pegs. Given the economic dominance of the US, monetary integration between Canada and Mexico would involve either fixing the Canadian and Mexican exchange rates to the US dollar or adopting a North American currency which would be largely influenced by the US (Carr and Floyd (2008)).

Substantial literature assesses the similarity of NAFTA countries' output and the impact of US output shocks in particular. For example, Murray (2000) and Murray *et al.* (2003) showed that there was substantially less cross-border integration than within-border integration between regions. Further, Fernandez and Kutan's (2005) analysis suggested that the NAFTA countries' business cycles were asynchronous. In contrast, other studies show linkages and shock symmetries between Mexico, Canada and the US (Swiston and Bayoumi (2008), Klyuev (2008), Holman and Neumann (2002)) and the existence of common trends in business cycles (Ponce and Acosta (2008), Jean Louis and Simons (2007); Kose and Cardarelli (2004), Cuevas *et al.*, (2003), Hernandez, (2004)).

Several techniques have also been used to gauge the extent of economic integration between NAFTA countries. Using descriptive statistics, Arndt (2006) has argued that *de facto* integration has been occurring as a result of cross-border production networks which have reduced cyclical divergence of the two economies, thereby providing a justification for monetary union. Similar results were shown for Mexico by Torres and Vela (2003). Michelis (2004) analyzed trade data, and GDP correlations, and tested for co-integration to find that Canada and the US satisfied the necessary conditions for an OCA, while Mexico and the US did not satisfy those conditions. Levine and Carkovic (2001) assessed the feasibility of Mexican adoption of the US dollar based on whether or not doing so would lower inflation and reduce exchange rate volatility. In general, the authors' results did not support adoption of the US dollar by Mexico. Lastly, Cooley and Quadrini (2001) examined the welfare impact on Mexico of losing monetary independence. The authors concluded that the loss of long-term monetary independence generated significant welfare losses. Most of these studies fall short as assessments of the effects of having a single monetary policy under a monetary union. Similarity of business cycles is important in

[2] A dynamic stochastic general equilibrium (DSGE) model can be worked out nicely to provide a theoretical foundation for this paper in lieu of the intuitively appealing idea outlined. However, for this time, we only concentrate on the empirical aspects, hence the use of the identified VARs, and leave the theoretical underpinnings for future work. Actually, we have already started such work.

determining whether countries need separate monetary policy to respond to economic conditions, but determining the reaction of Mexico and Canada to US monetary policy shocks also needs to be addressed. If Mexico and Canada already react substantially and similarly to a US monetary policy shock then additional shocks to their economies will be less severe as a result of monetary integration. Several papers with similar analyses to this paper are discussed below.

The literature assessing the impact of US output shocks on Canada and Mexico is more substantial than the literature assessing US monetary shocks. However, there is also a growing amount of literature that assesses US monetary policy impacts on Canada and, to a lesser extent, Mexico. Holman and Neumann (2002) used Choleski decompositions to examine the impact of US monetary policy shocks on Canadian economic activity. The authors acknowledged that a structural analysis could be imposed by restricting the impacts of Canada's shocks on the US. In regards to Mexico, Del Negro and Obiols-Homs (2001) used counterfactual experiments to compare four monetary policy regime periods that occurred between 1976 and 1997. The authors examined the indirect effect of a US policy shock on changes in Mexican monetary policy regimes. The paper's results suggested that US monetary policy disturbances were a large source of macroeconomic disruptions in the Mexican economy because of their effect on the policies of the Banco de México. There was only a cursory examination of the impulse response of Mexican macroeconomic variables to a federal funds rate shock, which relied on an under-identified VAR.

Swiston and Bayoumi (2008) assessed the impact of output, financial and trade channel shocks to the output of Canada and Mexico arising from the US, the Euro area, Japan and the rest of the world using a quasi-Bayesian VAR approach. The authors used a similar full sample and sub-sample as we use in our exposition. In terms of variance decompositions, US financial spillovers (interest rates and equity prices) accounted for one-half and two-fifths of US spillovers to Canada and Mexico, respectively. In contrast, financial linkages explained close to 20% of Mexico's output variation in the full sample period. Financial linkages in both countries increased over time, accounting for only a quarter in Canada before 1989 but more than half since 1989. This change was attributed to the inception of the Canada–United States Free Trade Agreement and to the reduction of domestic business cycle volatility in Canada, Mexico and the US.

A paper by Klyuev (2008) examined financial linkages between the US and Canada using a SVAR with a block exogeneity assumption (US macroeconomic variables affect the output and inflation of Canada and Mexico, but not vice versa). The author examined the impact of US output shocks on Canada's output, and the response of Canada's interest rate and output to a US monetary policy shock. Only 5% of Canada's output variation was explained by a US policy shock. The impulse response of Canadian and US output and inflation to a US monetary policy shock was similar to our results, with a peak negative output response and positive inflation response by the third quarter. Lastly, Bhuiyan (2008) used an open economy structural VAR to estimate the impact of monetary policy shocks arising from Canada and the US. The author used an over-identified VAR with a Bayesian Gibbs sampling method. Bhuiyan's results indicated that US variables (federal funds rate, US GDP, US inflation rate and world export prices) explained up to 60% of Canadian output variation. The US federal funds rate had a negative impact on Canada's GDP, but increased the inflation rate (the price puzzle).

By not including Mexico, other studies (except for Swiston and Bayoumi (2008)) fall short as an assessment of the feasibility of a NAMU. Our paper is similar in that it assesses the *direct financial channel* as represented by the three-month interest rate, but different because it compares the impact on both Mexico and Canada, and correlates the results. This paper contributes to the literature by using an SVAR to compare the impact of a monetary policy shock from the US on Canada and Mexico. This analysis is important because the Canadian and Mexican economies have become increasingly integrated with the US economy in terms of the volume of trade and in terms of formal trade agreements. If Canada and Mexico already react similarly and significantly to US monetary shocks and the magnitudes of the responses are the same, then a monetary union would be less costly because a common currency would not generate additional monetary shocks that would require adjustments by the Canadian and Mexican economies.

Section 4 Methodology

This paper uses the SVAR method to determine the impact of US monetary policy shocks on Canada and Mexico. This methodology has been used extensively in economics since Sims (1986) and Bernanke (1986) used short-run restrictions, and Blanchard and Quah (1989) used long-run restrictions to model innovations using economic analysis in response to Cooley and Leroy's (1985) critique of Sims's (1980) unidentified VAR. Further improvement in the SVAR technique was brought about with the work of Galí (1992), which combined short- and long-run restrictions to identify the model.

For Canada and Mexico, we estimate the following model where i_t^* is the nominal fund rate, and y_t and π_t are the respective country's output growth and inflation variables.[3] The asterisks are response coefficient estimates when included in a matrix.

$$\begin{bmatrix} i_t^* \\ Y_t \\ \pi_t \end{bmatrix} = \begin{bmatrix} * & 0 & 0 \\ * & * & 0 \\ * & * & * \end{bmatrix} \begin{bmatrix} \varepsilon^p \\ \varepsilon^S \\ \varepsilon^d \end{bmatrix} \qquad (1)$$

We impose the restriction that AD and AS shocks do not influence the US short-term interest rate (the first two zeros of the first row) and AD shocks have no contemporaneous effect on Y because supply is perfectly inelastic in the short run due to the availability of resources (the zero of the second row). We assume that it takes at least one quarter before we can observe the effect of AD on output, which is not unreasonable, as we are dealing with quarterly data.

For the US, which is the large country, we estimate the following model:

$$\begin{bmatrix} Y_t^* \\ \pi_t^* \\ i_t^* \end{bmatrix} = \begin{bmatrix} * & 0 & 0 \\ * & * & 0 \\ * & * & * \end{bmatrix} \begin{bmatrix} \varepsilon^s \\ \varepsilon^d \\ \varepsilon^p \end{bmatrix} \qquad (2)$$

[3] This basic model assumes that monetary policy in the two small countries is imported from the US under the assumption of perfect capital mobility. This might seem quite restrictive a priori because we do not allow the domestic interest rate at this point to be part of the model. We address this issue later by estimating octavariate VARs. The results obtained from the basic model are robust.

The restrictions adopted for the US VAR are straightforward. Neither the policy shock nor the AD shock has a contemporaneous effect on output growth and the policy shock does not have a contemporaneous effect on inflation. It takes some time for adjustment to take place. The underlying identification scheme of the VARs is consistent with the theoretical underpinnings of the basic Mundell–Fleming or IS-LM-BP model. This model depicts an economy that is so small that it is affected by the outside world but does not affect the outside world.

It is worth noting that the structural decomposition adopted here is not a Choleski decomposition, although it is similar in appearance. The careful ordering of the variables is thought to reflect the underlying theory of the IS-LM-BP model. The decomposition adopted here is one of the six possible orderings of the Choleski decomposition.

Section 5 Data and Data Analysis

The data were taken from the OECD Economic Outlook database. The nominal fund rate is used as the US monetary policy shock variable. The interest rate is used in line with Bernanke and Blinder's (1992) contribution that innovations in the US federal funds rate are a better measure of monetary policy shocks than innovations in monetary aggregates. Further, Sims (1992) noted that money demand shocks reduce the accuracy of monetary aggregates as a measure of monetary policy shocks. Sims suggested the use of the short-term interest rate. Thus, our paper uses the nominal fund rate as a measure of US monetary policy shocks.[4]

The other variables used in this paper are Mexico's and Canada's Gross Domestic Product (GDP) and Consumer Price Index (CPI). GDP and the CPI are used in first-differenced natural logarithmic form, and therefore represent output growth and the inflation rate in the estimated VARs. The data are quarterly and run from 1970:1–2008:4. In addition, two sub-samples are used to estimate the periods before and after the adoption of inflation targeting policies. For the US, the implicit inflation targeting period runs from 1985:1–2008:4, which is based on the beginning of a period of inflation control activism by the Federal Reserve (Cogley and Sargent (2001)). For Mexico, the period of implicit inflation targeting is based on the more stable period of inflation from 1988:3 to 2008:4, which started with the adoption of a currency peg to the US dollar under the *Pacto de Solidaridad Económica* (which was later dropped after the Tequila Crisis in which inflation spiked and the peso was devalued).[5] For Canada, the period of inflation targeting is based on when the Bank of Canada began explicit inflation targeting in 1991:1 (a one quarter lag (1991:2) is used because targeting was gradually implemented).

A dummy variable representing periods with and without inflation targeting was included in the full period VARs as an exogenous variable. A linear trend was included in all of the VARs as an exogenous variable. Lastly, a dummy variable for oil shocks was included in Mexico and Canada's VARs as an exogenous variable, because of the importance of oil in those economies. The first oil shock period started in 1973:4, which corresponds with the beginning of the Arab oil embargo on October 19th, 1973. The effect of the shock continued until November 1979, when a second oil shock occurred due to cancellation of US oil contracts by Iran and an increase in prices by Saudi Arabia. Oil prices returned to normal levels by 1986:1. A brief shock occurred

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[4] Our findings still hold even when we use the fund rate as the monetary policy instrument.

[5] It would be preferable to start Mexico's sample later when explicit inflation targeting was adopted, but the sample size would be too small for quarterly data.

during the Gulf War for approximately two quarters (1990:3–1990:4). Lastly, the most recent shock, in large part attributed to speculation, started in approximately 2003:1 and has continued until the end of the sample period (2008:4). The oil shock is statistically significant in Mexico's full sample and the pre-targeting sample, and is only significant in Canada's targeting sample with a lag length of four. These results are in line with the decrease in importance of oil in Mexico's economy and the increase in the importance of oil in Canada's economy. Therefore, the oil shock variable is only included in the VARs in which the dummy variable was statistically significant.

Table 1 shows the unit root test results for the three sample periods. The Augmented Dickey–Fuller (ADF) and the Dickey–Fuller Generalized Least Squares (DF-GLS) unit root tests are shown using a lag of 13 with an intercept and trend. For the full period (1970:1–2008:3), all variables have unit roots. The non-stationary CPI and output series in Figures 2 and 3 respectively are made into differenced stationary series for the estimated VARs. For the period before inflation targeting (1970:1–1984:4 for the US, 1970:1–1988:2 for Mexico and 1970:1–1991:1 for Canada), all of the variables have unit roots, except for the US CPI (ADF and DF-GLS). The output and CPI series were made into differenced stationary series for the estimated VARs, except for the US CPI, which was estimated in levels. However, the graph plot shows that the US CPI is clearly non-stationary. Due to these counterintuitive results, another VAR was estimated with the US CPI in first differences. For the period of inflation targeting (1985:1–2008:3 for the US, 1988:3–2008:3 for Mexico, and 1991:2–2008:3 for Canada), all the variables had unit roots except for Mexico's GDP (DF-GLS) and the US three-month rate for the Canadian and Mexican sub-sample periods (ADF and DF-GLS). Thus, the output and CPI series were made into differenced stationary series for the estimated VARs, except for Mexico's GDP, which was estimated in levels. A plot of Mexico's GDP also indicated that it was non-stationary; therefore, another VAR was estimated with Mexico's GDP in first differences. Most of the interest rate unit root tests are anomalous because they indicate that the monetary policy variable is non-stationary for most sample periods. In light of the unit root test results that are inconsistent with the theory that interest rates tend to revert to their mean, the results with all of the interest rate in levels (and the US CPI and Mexico's GDP in first differences) are included in the companion Supplement[6] and are contrasted with the differenced VARs that are discussed in this paper.

Table 1 about here
Figure 2 about here
Figure 3 about here

We also conducted analysis of the decade-by-decade average and volatility of quarterly output growth rates for the US, Mexico and Canada. Output growth was highest in the 1970s for all three countries. Except during the 1980s, Mexico's GDP growth was larger than GDP growth in

[6] **The Supplement is intended for the referees' information and is not for publication. However, it will be available upon request to interested readers. The Supplement also contains plots of real interest rate, decade-by-decade comparative analysis of output growth, and inflation performance and US monetary policy, impulse responses based on estimation with 4 and 6 lags for some variants of the VARs, impulse response correlations and variance decomposition results based on estimation with 6 lags, among others.**

the US and Canada. The standard deviation of Mexico's GDP is about 1.5 times higher than that of the US and Canada, except during the 1970s, which was a period of relatively stable growth in Mexico. In three out of the four periods, the US had a slightly more variable growth rate than Canada. Overall, the decade-by-decade behavior of US output growth is most similar to Canada's output growth. This is demonstrated by the correlation coefficients in Table 2, which indicate that the US and Canada's output growth is driven, although weakly, by similar shocks. In contrast, the correlations of output growth between Canada and Mexico, and between the US and Mexico, are low and mostly statistically insignificant.

Table 2 about here

With respect to quarterly inflation, the decade-by-decade average and volatility analysis show that Mexico's inflation rate was higher than Canada's and the United States' inflation rate for all four decades, particularly during the 1980s and 1990s. In the 1980s, Mexico's inflation rate averaged almost 14% compared to 5% and 6% in Canada and the US, respectively. The standard deviation of Mexico's inflation rate was also much higher in all four decades, peaking at 8% during the 1980s compared to less than 1% for Canada and the US. The highest quarterly inflation rate was nearly 4% in Canada and the US during the 1970s, and 39% in Mexico during the 1980s. Except in the 1970s, Canada's inflation rate was slightly more volatile than that of the US. Table 2 shows that factors driving inflation in the US and Canada, be they demand-pull or cost-push, are relatively similar. The correlations of inflation between Canada and Mexico and between the US and Mexico are low and statistically insignificant. The high correlation between Canada and the US and the low correlations with Mexico are indicative of the similar inflation policies practiced by Canada and the US.

Lastly, the US three-month Treasury bill rate was highest during the 1980s in response to the high inflation rate during the 1970s, while the inflation rate was lowest during the 2000s. The downward trend in the interest rate since the 1970s and 1980s helps explain why the unit root test results indicated non-stationarity.

Section 6 Empirical Results

The Investment Sensitivity Analysis

As a prelude to the VAR analysis, we estimate the sensitivity of gross investment (in logarithmic difference form) to the real fund rate for both Canada and Mexico, presenting the results in Table 3. Regardless of whether we use the simple Ordinary Least Squares (OLS) or the dynamic OLS of Stock and Watson (1993) with White Heteroskedasticity-Consistent Standard Errors & Covariance, we find the coefficient estimate for the real fund rate in the regression for Mexico is approximately four times as large as that for Canada, suggesting that the two countries do indeed exhibit differing sensitivities to US monetary policy. A one percentage point increase in the real fund rate reduces gross investment by 20 and 6 basis points for Mexico and Canada, respectively. The implication of this finding is that even if the shocks that hit the countries initially provoked an output gap of the same magnitude, common monetary policy could still be destabilizing when the speed of adjustment back to full employment equilibrium is taken into consideration. However, common monetary policy could be beneficial if the output gap of Mexico is greater than that of Canada. Normally, there is no reason to expect the contrary. As a developing nation, it is very likely that Mexico's output gap is larger than that of Canada, a developed country. The recent housing meltdown in the US that has spread over the world demonstrates this relationship. Mexico saw a decline in output of the magnitude of 8.2% on average for the first six months of 2009, while Canada recorded a decline of only 2.3% over the same period. Therefore, our contention that it is not reasonable to expect two countries to respond in the same way or to suffer or benefit in the same magnitude from a shock sits on firm grounds. In a few words, the strict definition of symmetry does little in determining whether a monetary union is feasible amongst countries. Instead, our proposition is to concentrate on whether the responses to policy shocks are directly correlated and whether interest-sensitive components of the economies are relatively similar.

Table 3 about here

The SVAR Analysis

This paper employs a trivariate SVAR with the lower triangular structure $Z_t = [i_t, y_t, \pi_t]$, because the monetary policy instrument i_t is the most exogenous variable and does not respond contemporaneously to supply or demand shocks, and output growth y_t does not respond contemporaneously to demand shocks, while inflation π_t responds contemporaneously to all variables.

For comparison purposes, we also estimated a trivariate SVAR with four lags for the US using a lower triangular ordering of the variables common to the literature, say $W_t = [y_t, \pi_t, i_t]$, which implies that neither policy shock nor inflation shock from the US affects real economic activity contemporaneously, and policy shock does not produce contemporaneous effects on inflation. The last equation is referred to as a contemporaneous policy rule, which is standard in the literature. Our main goal is to determine whether the NAFTA countries react similarly to monetary policy shocks from the US.

The Akaike Information Criterion and Swartz Criterion were used to test for the appropriate lag order, but these tests did not give robust lag suggestions for the VARs, with several high lag suggestions of 12 and 10 (which either had or almost had autoregressive roots outside of the unit circle), as well as several weaker suggestions of one and two lags. The problem was particularly severe for the sub-sample periods. Instead, the VARs were run using lag lengths of four, which is standard for quarterly data. The VARs were also estimated with lag lengths of six in order to test for lag length sensitivity. Our exposition focuses on the VARs with lags of four, while the results for the VARs with lags of six are included in the Supplement and compared when appropriate.

The reduced form VARs were tested for stability because statistical inferences based on the standard errors (impulse responses and variance decomposition) are not valid if any of the roots fall at the border or outside the unit-root circle. All the autoregressive roots were strictly between -1 and 1, indicating that the VARs were stable.[7] We summarize the empirical results in Figure 4 and Table 4, but present the impulse responses of each country's sets of variables with four and six lags for the different sample periods in the Supplement for Canada, Mexico and the US,

[7] The results related to the VAR stability tests are not presented here but are available upon request. The same applies for the impulse responses with error bands, and the variance decomposition of the VAR estimated with interest rate and output in differences for Mexico.

respectively, where the dotted lines are 95% confidence bands (analytical) and the solid lines are point estimates.

Figure 4 about here
Table 4 about here

The price puzzle was present in all VARs except for two of Mexico's VARs. Sims (1992) argued that the price puzzle occurs because the central bank has more information about future inflation than a simple VAR can adequately capture. The price puzzle is a frequent anomaly in VAR estimation, various approaches have been discussed in the literature to deal with the problem (see Christiano, Eichenbaum and Evans (1999), Barth and Ramey (2001), Leeper and Roush (2003), Hanson (2004); Giordani (2004); Chowdhury et al. (2006) and Bache and Leitemo, (2008)). Most recent contribution by Bhuiyan (2008) suggests that the price puzzle is a result of a change in the US terms of trade that results from an increase in its interest rate.

The correlation of impulse responses are presented in Table 4. The full sample and pre-targeting VARs are discussed together because their impulse responses are similar. In these two samples, Mexico and the US have asymmetric output growth and inflation responses, while Canada and the US have strong symmetric responses to a US policy shock.[8] Canada and Mexico have a symmetric output growth response in the full sample, but a weakly asymmetric response in the pre-targeting sample. For the pre-targeting sample, Canada's output response peaks at -25 basis points in the fourth quarter, while the US output response peaks one quarter earlier at -50 basis points. Mexico's output response peaks at 35 basis points a quarter later than Canada.

The inflation response correlations in the pre-targeting VARs are similar to output growth but the responses of Canada and the US are positive while Mexico's responses are negative. The inflation response correlations are stronger for output growth in both sample periods. The inflation response of Canada and Mexico and Mexico and the US are asymmetric for the full and earlier sample VARs. The stronger impulse response correlation of inflation for Canada and US is consistent with the stronger correlation of inflation shown in Table 2. With a maximum impact of -65 basis points in the first quarter for the pre-targeting sample, the Mexican inflation response is much larger than the Canadian and US inflation response. The larger inflation response is consistent with the high level of inflation experienced by Mexico throughout the sample periods. The output growth and inflation impulse correlation results are fairly consistent across alternative lag lengths, except that Mexico's responses are more erratic with six lags. The full period impulse responses are lower than the pre-targeting impulse responses. This difference is due to the larger and more volatile behavior of the three-month rate during the earlier sample periods, which resulted in larger structural shocks for all of the VARs.

What do the impulse response correlations suggest in terms of the feasibility of monetary union? For this, we go back to Figure 4 and calculate the correlations so that we can arrive at the

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[8] The impulse responses are correlated until the responses of both variables die down to less than one basis point in order to minimize the inclusion of impulse response values that are of such small value that they are insignificant. For most VARs, the impulse responses did not die down to one basis point until the mid-twentieth quarter.

averages that are presented in Table 4.[9] The inflation pre-targeting sample unequivocally shows that a monetary union is feasible only between Canada and the US. Canada and Mexico react asymmetrically to US monetary policy shocks. The inflation targeting sample tells a different story, although the correlations are very weak and statistically insignificant: Canada and Mexico's responses are similar, whilst Canada and the US are no longer suitable candidates. For the linkages between Mexico and the US, output responses are dissimilar but inflation responses are not. The two major shifts in policy that occurred in the 1990s may help explain the results of the inflation-targeting sample. During this time, Canada adopted domestic monetary policies that distanced its economy from the US, while Mexico embraced policies that brought its economy closer to the US. In the early 1990s, the Bank of Canada deviated drastically from US monetary policy by starting to target inflation and keep it within the range of 1–3%. As a result, a wide gap emerged between the two short-term interest rates, with severe consequences in terms of employment and output, which Fortin (1996) called "The Great Canadian Slump".[10] Instead, Mexico adopted policies in 1989 to peg its currency to the US dollar, but suffered a setback in 1994 with the peso crisis and was forced to let its currency float freely. Since then, the Banco de México has implemented strategies to target inflation while the peso fluctuates in the foreign exchange market. When we take the average for the full sample period, we find that Canada and the US are suitable for a monetary union, Mexico and the US are not, and Canada's and Mexico's output responses to a US monetary policy shock are positively correlated but inflation responses are not. These findings are then compared with the average of the averages of the pre- and inflation-targeting period; we then realize that it is the pre-targeting sample results that dominate.

We test whether the results are sensitive to the order of integration of the short-term rate by re-estimating the VARs with the US interest rate in levels and summarize the results in Figure 5 and Table 5, whilst detailed impulse responses with error bands are inserted in the Supplement. Figure 5 shows that the VAR estimates with the interest rate in levels have a stronger correlation for output growth and a weaker correlation for inflation than the estimates in first differences. Mexico's output growth is more strongly correlated with Canada's but has a weaker correlation with US output growth in response to a US monetary policy shock, but Canadian and US variables display a statistically high and significant response for the pre-targeting and full sample. Table 5 presents the average of the correlations. The finding that only Canada and the US are suitable for a monetary union still holds firmly. However, there is one notable difference: Mexico's negative output and positive inflation responses in the pre-targeting and full sample VARs are the opposite of what was found when the VARs were estimated with the interest rate in first differences. In addition, the inflation correlations between Mexico and the US, and between Canada and the US are insignificant for the pre-targeting VARs when the US CPI is estimated in first differences. In contrast, for the other pre-targeting VAR estimates, the correlations with the US are much stronger.

Figure 5 about here

Table 5 about here

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[9] Although results based on estimation with 6 lags are part of the Supplement, we also present here the average of results with 4 and 6 lags.

[10] It is worth emphasizing that Canada's Bank rate had been realigned to the fund rate later in the decade.

The inflation targeting VARs differ substantially from the pre-targeting and full sample VARs. The correlations are much lower and the variance decompositions are subject to significant lag length sensitivity (see below). All of the VARs for this period exhibit larger standard errors, smaller impulse responses and more erratic response behavior. The smaller impulse responses are, in part, the result of the reduced output, inflation, and US policy shock size and volatility experienced during the later sample periods. The impulse responses and correlations are similar whether or not the US interest rate is estimated in levels (Figure 4 and Figure 5) or whether Mexico's GDP is estimated in first differences (Figure 4 and Figure 6). Most VARs, whether in levels or differences, exhibit a small negative correlation in impulse responses between Canada and the US. Mexico's and Canada's output growth have a small negative correlation, while their inflation has a positive correlation. US and Mexican output growth correlations are mostly negative, while the inflation correlations are mostly positive. Further, the size of Mexico's impulse responses dwarfs those of Canada and the US. The results of Klyuev (2008), which used a short sample (1991:1–2007:1) with quarterly data, had similarly poor results, which suggest that shocks are more difficult to identify using a shorter sample period.
Figure 6 about here

The full sample impulse response of the US and Canadian inflation and output growth are similar to the impulse response of Klyuev (2008) and slightly less similar to the impulse responses of output estimated for Canada in Bhuiyan (2008). Our VAR estimates show that the US and Canada consistently have a high level of both output growth and inflation response correlation for two of the sample periods. In contrast, a significant asymmetry exists between Mexico and the US, while Canada's and Mexico's output growth responses are similar and the inflation response is asynchronous. As is evident from Figure 6, we have factored all the possibilities dictated by the unit root results into the VARs. We account for stationarity and non-stationarity of the interest rate and CPI for the US, and output for Mexico with different lag lengths. The results are robust: Canada and the US are suitable for a monetary union with each other but not with Mexico.

Tables 6 shows the variance decompositions for output growth and inflation for Canada, Mexico and US when the short-term interest rate is assumed to be stationary in differences. It bears reiterating that our discussion focuses on the VARs with 4 lags. On average, US policy shock affects Canada more than Mexico. For the full sample, policy shocks explain little of the output variation for Canada and Mexico. US policy shocks explain 12% of Canada's output variation and about 6% of Mexico's output variation. The US policy shock almost contributes as much to Canada's inflation, but it is a very small component of Mexico's inflation variance. For the full sample, the contribution of monetary policy shocks to Canada's output is about twice the size of the estimated contribution in Klyuev (2008). The output impact of US monetary policy on Canada for our full sample VAR is most similar to Holman and Neumann (2002)'s results using a Choleski decomposition, which estimated a contribution of 10% towards Canada's output arising from US monetary policy shocks.
Table 6 about here

The period before inflation targeting shows that US monetary policy explains 18% of Canada's output variation and 20% of Mexico's output variation. Before the targeting period, close to 36% of Canada's inflation was explained by the policy shock, while the policy shock only explained a small proportion of Mexico's inflation. The variance decompositions of the inflation targeting VARs are subject to lag length sensitivity, with lags of six showing US policy shocks to be more important for both output growth and inflation. For the inflation-targeting VARs, the policy shock explains a similar proportion of Canada's output variation as the pre-targeting sample, but a much lower proportion of Canada's inflation. For Mexico's implicit inflation-targeting VARs the variance decompositions of output growth and inflation are still weakly explained by US policy shocks. These features are present even when the VARs are estimated with Mexico's output in first differences, although the variance decomposition of output growth is smaller and less sensitive to the number of lags.

Tables 7 shows that the variance decompositions of the level interest rate VARs are similar, except that for the pre-targeting VAR where differences in the variance of Mexico's output growth are better explained by the US policy shock.[11] Further, the full sample and post-targeting VAR in levels shows that the policy shock is a more important contributor to Mexico's inflation. Comparing the pre-targeting sample to the targeting and full sample VARs suggests that policy shock has become a less important determinant of Mexico's output growth and a less important determinant of Canada's inflation. These results differ from those of Swiston and Bayoumi (2008), although our full sample variance contribution of US policy shock to output growth was similar to their results for Canada.
Table 7 about here

Further Robustness Tests and Empirical Evaluation
In our paper, we had included a dummy variable in the VARs of Canada and Mexico to differentiate between periods involving major oil price shocks. It may be difficult for some to interpret this exogenous variable within the VAR. It might make more sense to include an actual measure of the oil price directly in the VAR. We remedy this potential problem following Kilian (2009)'s work, where oil prices in US VARs are endogenous.

In the first part of Section 5, we discussed the response of investment to interest rates and showed how this differs across countries. However, this variable was not included in the VARs. As many would believe, if there is a distinctly important role for investment then perhaps we ought to include it in the VARs to integrate it better with the rest of the paper. Also, it might be hard to see why the identification of the US VAR is based on such different assumptions than that of the Canadian and Mexican ones. For example, the US VAR has US inflation reacting slowly to a nominal fund rate shock, while in Canada and Mexico, the inflation rates react immediately to a US nominal interest rate shock. Notwithstanding that the identification scheme is in line with the basic Mundell–Fleming model, it would still come as a surprise to the Mexican and Canadian central banks that their own policy interest rates do not affect their domestic inflation rates. In addition, since the US interest rate is the only US variable in the separate VARs for each small open economy, it might be difficult to convince readers that we have indeed identified shocks to US monetary policy when other US variables are not included in the VARs.

[11] Note that the inflation targeting VAR for Canada is the same, because the DF-GLS unit root test indicated that the US short-term interest rate was stationary for Canada's and Mexico's sample period. Mexico's inflation targeting is slightly different because the DF-GLS unit root test indicated that Mexico's output was stationary. This was probably due to the large output contraction that occurred during Mexico's Tequila Crisis.

To address the potential pitfalls noted, we estimated a pair of two-country SVARs with common US variables. We took this route not because we believe there is much feedback from Canada and Mexico to the US, but because this is the most suitable approach to address the many issues to resolve, even though smaller VARs are preferable to larger ones in terms of degrees of freedom. For Canada, we estimated an octavariate SVAR with lower triangular structure $C_t = [P_{oil}, y_t^{US}, \pi_t^{US}, i_t^{US}, y_t^{CAN}, \pi_t^{CAN}, i_t^{CAN}, I_t^{CAN}]'$ over the full sample (1970–2008), the pre-targeting inflation period (1970-1990), and the inflation-targeting period (1991–2008) with four and six lags. For Mexico, a similar model, $M_t = [P_{oil}, y_t^{US}, \pi_t^{US}, i_t^{US}, y_t^{MEX}, \pi_t^{MEX}, i_t^{Mex}, I_t^{MEX}]'$, was estimated over the period 1981–2008 because the lack of data points on gross investment and the T-bill rate for 1970–1980 did not permit us to differentiate between pre- and inflation-targeting periods. The variables are the percentage change in the price of oil (P_{oil}), the output growth/output gap (y_t), inflation (π_t), changes in fund rate (i_t^{US}), bank rate (i_t^{CAN}), and T-Bill rate (i_t^{Mex}) and the percentage change in gross investment (I_t). With this setup, we do not allow the small country's variables to have contemporaneous effects on the large country's variables (see Cushman and Zha, 1997), but oil price shocks affect all variables.[12]

The results show that, irrespective of the measure of output incorporated in the VARs or the sample considered, there is strong evidence of a statistically significant positive correlation of output and inflation responses to US monetary policy and oil price shocks between Canada and the US, as presented in Table 8. There are two instances, however, where the correlation of output gap responses is below 10% and one where it is negative. We find stronger linkages between Canada and the US for the inflation-targeting period than we initially documented for the trivariate models. Table 9 compares Canada and Mexico with the US using the same criteria. It indeed confirms that a monetary union would be more appropriate between Canada and the US than between Mexico and the US. There are only three cases where the correlation of responses for Mexico–US is greater than that of Canada–US. With respect to the response of gross investment to US monetary policy shock, Table 9 also shows that Canada and Mexico do exhibit differing sensitivities. The maximum correlation is 32% and is sensitive to lag length when output growth enters the VAR. With output gap, the correlation lies between 22% and 26%, suggesting that common US monetary policy can work for both Canada and Mexico only if the output gap of Mexico exceeds that of Canada, as found earlier.
Table 8 about here
Table 9 about here

In Tables 10 to 15, we present the forecast error variance decomposition of output growth, output gap, inflation and the percentage change in investment. The results show that oil prices and US variables play an important role in the variations of Canada's macroeconomic variables, irrespective of the sample period considered. Although there is evidence that Canada's bank rate affects domestic inflation rate, among other variables, there is clear dominance of the fund rate in

[12] The recursive ordering of the variables are carefully thought in line with the conventional assumption that oil prices are not primarily determined on the basis of domestic macroeconomic variables (see Kilian and Vega 2010). Following Christiano *et al.* (1999), monetary policy shocks are identified as the residual of each country's interest rate after allowing for the contemporaneous influence of all variables ordered above the short-term interest rate. One important feature of this VAR ordering is the embedded monetary policy reaction function of a small open economy where the policy interest rate reacts to foreign policy interest rates and other foreign variables.

various instances. We compare the proportion of forecast error for Canada and Mexico in Tables 16 to 18, and find that oil price shocks have stronger effects on Canada than on Mexico, but there is no substantial difference in the influence of the fund rate relative to the domestic policy interest rate across countries. Overall, the findings of this paper are robust.

Tables 10 to 15 about here
Tables 16 to 18 about here

Section 7 Conclusion

This paper has examined the feasibility of a North American Monetary Union by assessing whether Canada, Mexico and the US exhibit similar responses to US monetary policy shocks and whether AD and AS shocks are symmetric. Three different sample periods were used: a sample from 1970:1–2008:3, sub-sample periods before inflation targeting, and sub-sample periods after inflation targeting. Short-run restrictions were used to identify the VAR by assuming the small country–large country hypothesis, in which Canada's and Mexico's AD and AS shocks do not affect US monetary policy, and by assuming that output does not react contemporaneously to AD shocks. For the US, a different ordering was used to account for the large country status of this country. The US VAR was identified using short-run restrictions whereby AD and policy shock have no contemporaneous effect on output, and monetary policy shock does not affect inflation instantaneously.

Output growth and inflation responses for Canada and the US exhibit a strongly symmetric impulse response to a one-standard-deviation US policy shock. In contrast, the impulse responses of Mexico and the US are asymmetric. Canada's and Mexico's output growth react similarly to US policy shocks, but their inflation does not react similarly to US policy shocks. Our results lend partial support to the feasibility of a monetary union between Canada and the US, but not with Mexico as a member. Mexico and Canada exhibit differing investment sensitivities to the US real interest rate, which further weakens support for the inclusion of Mexico in a North American Monetary Union.

Further robustness tests were conducted to address issues related to the use of a dummy for periods of major oil shocks as opposed to oil price, and the absence of other US macroeconomic variables to fully capture monetary policy shocks.

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Table 1: Unit Root Tests		
Exogenous: Intercept and Trend Lag Length: 1 (Automatic based on SIC, MAXLAG=13)		
	ADF	DF-GLS
Full Sample		
Fund Rate	-2.42	-2.40
T-bill Rate Mexico	-2.54	-3.04*
Bank Rate	-2.65	-2.37
GDP US	-3.53**	-2.93
GDP Mexico	-2.58	-1.14
GDP Canada	-2.88	-1.68
CPI US	-2.13	-1.27
CPI Mexico	-0.68	-1.11
CPI Canada	-2.64	-1.52
Before Targeting		
Fund Rate (1970:1-1984:4)	-2.27	-2.17
T-bill Rate Mexico (1970:1-1988:2)	-3.06	-2.68
Bank Rate (1970:1-1991:1)	-2.55	-2.61
GDP US	-2.57	-2.39
GDP Mexico	-1.19	-1.42
GDP Canada	-2.53	-1.48
CPI US	-4.32***	-3.78***
CPI Mexico	-0.38	-0.35
CPI Canada	-0.38	-2.80
Inflation Targeting Sample		
Fund Rate (1985:1-2008:4)	-3.40*	-3.78***
T-bill Rate Mexico (1988:3-2008:4)	-3.21*	-2.65
Bank Rate (1991:2-2008:4)	-3.31*	-2.04
GDP US	-2.12	-2.10
GDP Mexico	-3.40	-3.35**
GDP Canada	-1.11	-1.63
CPI US	-1.93	-1.66
CPI Mexico	1.11	-0.75
CPI Canada	-1.48	-1.23

The MacKinnon critical values at 1, 5, and 10% are -4.02, -3.44, and -3.14, respectively for the ADF unit root test and the Elliott-Rothenberg-Stock (1996) critical values at -3.65, -3.09, and -2.80, respectively for the DF-GLS unit root test.

*, **, and *** are 10, 5, and 1 per cent significance level, respectively.

Figure 2: Canada, US, and Mexico Prices (in Logs)

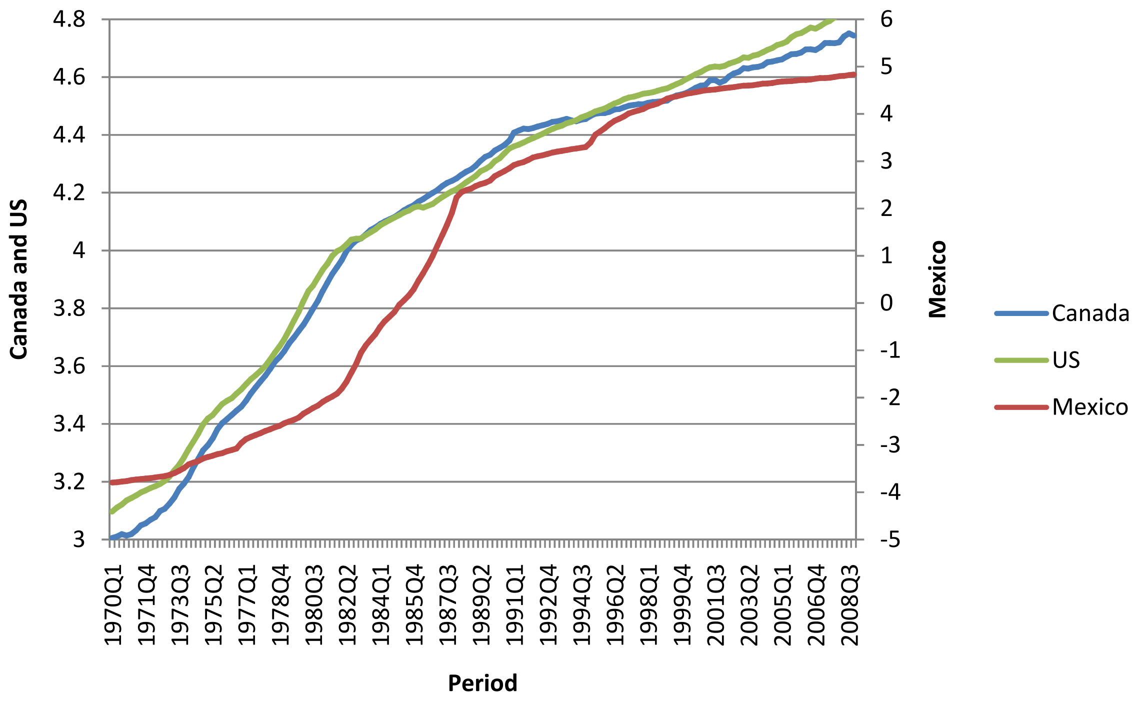


Figure 3: Canada, Mexico, and US Output(in Logs)

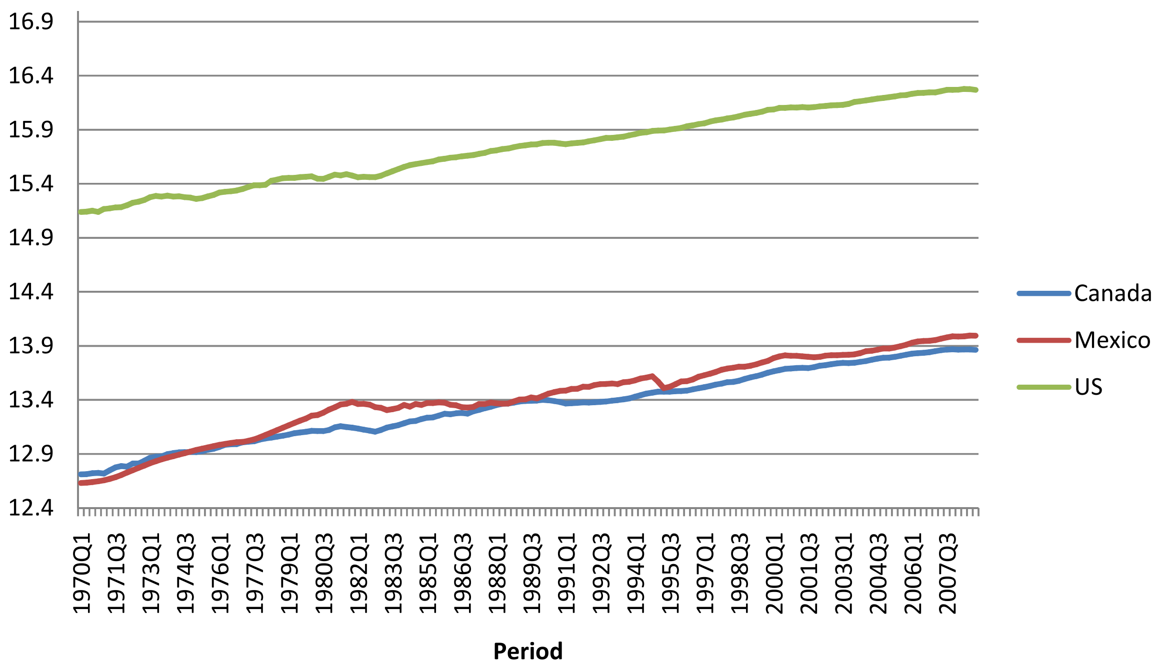


Table 2: Correlation of Output Growth and Inflation Across NAFTA Countries (correlation of inflation in right corner)			
	US	Mexico	Canada
US	1.00	**-0.02**	**0.75**
Mexico	**0.16**	1.00	**0.14**
Canada	**0.45**	**0.23**	1.00
The upper values above the diagonal are the correlation of inflation whereas those below are the correlation of output growth.			

Table 3: The Sensitivity of Investment to Real Fund Rate									
Dependent Variable: Log Difference of Gross Investment - Mexico					**Dependent Variable: Log Difference of Gross Investment Canada**				
Variable	Coeff-icient	Std. Error	t-Stat.	Prob.	Variable	Coeff-icient	Std. Error	t-Stat.	Prob.
C	12.58	0.08	166.55	0.00	C	11.51	0.03	440.38	0.00
R	-0.20	0.02	-8.99	0.00	R	-0.06	0.01	-9.72	0.00
DIFF_R	0.19	0.07	2.56	0.01	DIFF_R	0.05	0.02	2.24	0.03
DIFF_R(-1)	0.10	0.07	1.36	0.18	DIFF_R(-1)	0.01	0.03	0.58	0.56
DIFF_R(-2)	0.08	0.07	1.16	0.25	DIFF_R(-2)	0.02	0.03	0.88	0.38
DIFF_R(-3)	0.16	0.07	2.35	0.02	DIFF_R(-3)	0.07	0.02	3.35	0.00
DIFF_R(-4)	0.17	0.06	2.70	0.01	DIFF_R(-4)	0.07	0.02	3.33	0.00
DIFF_R(1)	-0.01	0.08	-0.08	0.94	DIFF_R(1)	0.01	0.03	0.32	0.75
DIFF_R(2)	-0.10	0.07	-1.49	0.14	DIFF_R(2)	-0.03	0.02	-1.16	0.25
DIFF_R(3)	-0.19	0.07	-2.90	0.01	DIFF_R(3)	-0.07	0.02	-2.91	0.01
DIFF_R(4)	-0.16	0.07	-2.18	0.03	DIFF_R(4)	-0.07	0.02	-2.81	0.01
R-squared	0.52	Mean dependent var		11.79	R-squared	0.51	Mean dependent var		11.27
Adjusted R-squared	0.44	S.D. dependent var		0.42	Adjusted R-squared	0.43	S.D. dependent var		0.14
Dependent Variable: Log Difference of Gross Investment - Mexico					**Dependent Variable: Log Difference of Gross Investment - Canada**				
Variable	Coeff-icient	Std. Error	t-Stat.	Prob.	Variable	Coeff-icient	Std. Error	t-Stat.	Prob.
C	12.33	0.07	167.30	0.00	C	11.41	0.03	422.27	0.00
R	-0.13	0.02	-8.17	0.00	R	-0.03	0.00	-6.73	0.00
R-squared	0.34	Mean dependent var		11.78	R-squared	0.19	Mean dependent var		11.28
Adjusted R-squared	0.33	S.D. dependent var		0.46	Adjusted R-squared	0.18	S.D. dependent var		0.15
White Heteroskedasticity-Consistent Standard Errors & Covariance									

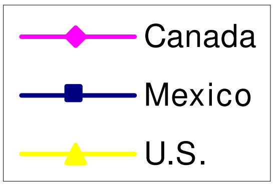


Figure 4 : Correlation of Non cumulative Response to One S.D. Monetary Policy Innovation +/- 2 S.E. – Estimated with Δi_t

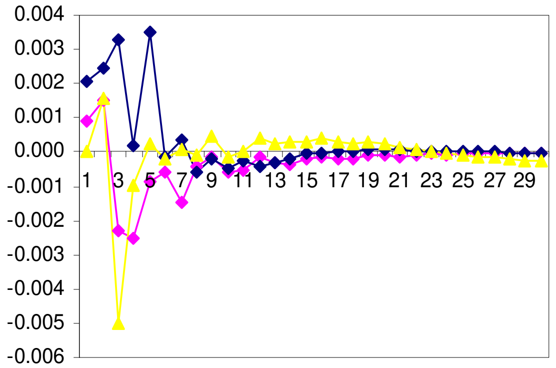
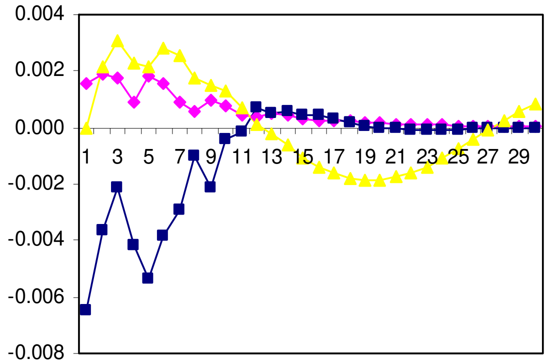
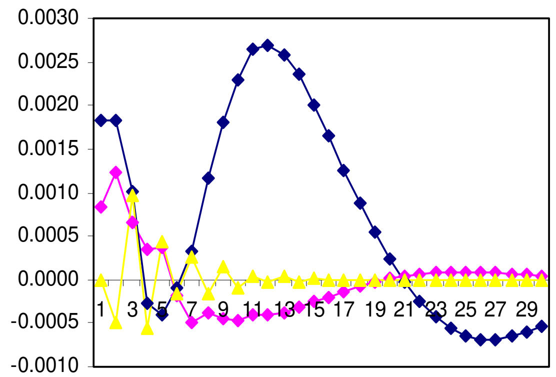
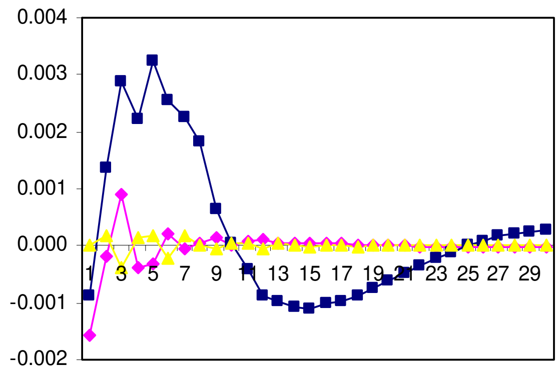
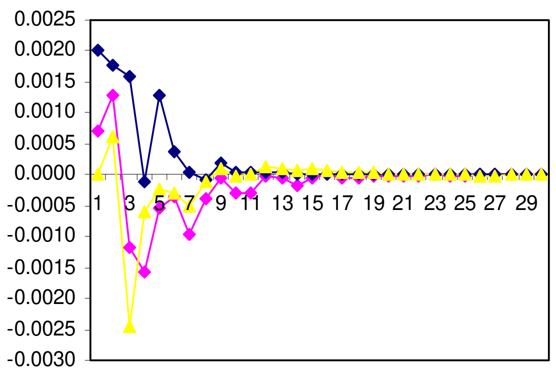
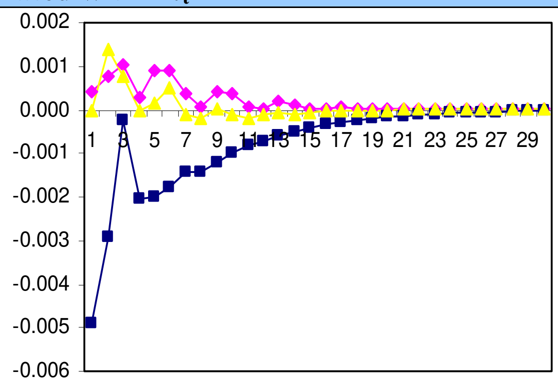
Output Growth	Inflation
Pre-targeting Sample – Estimated with Δi_t and US CPI_t	
Four Lags	
	
Inflation Targeting Sample – Estimated with Δi_t and Mexico y_t	
	
Full Sample – Estimated with Δi_t	
	

Table 4: The Averages of the Impulse Responses to US Monetary Policy Shock					
	Output Growth			**Inflation**	
Pre-targeting Sample – Estimated with Δi_t and US CPI_t					
4-LAG MODEL					
Correlation	Mexico	Canada	**Correlation**	Mexico	Canada
Canada	-0.05		Canada	-0.85	
US	-0.40	0.68	US	-0.65	0.75
Average Pre-Targeting Sample for 4 and 6 Lags					
Correlation	**Mexico**	**Canada**	**Correlation**	**Mexico**	**Canada**
Canada	**-0.04**		**Canada**	**-0.65**	
US	**-0.36**	**0.66**	**US**	**-0.47**	**0.81**
Inflation Targeting Sample – Estimated with Δi_t and Mexico y_t					
4-LAG MODEL					
Correlation	Mexico	Canada	**Correlation**	Mexico	Canada
Canada	-0.26		Canada	0.17	
US	-0.02	-0.02	US	-0.06	-0.51
Average - Targeting Sample for 4 and 6 Lags					
Correlation	**Mexico**	**Canada**	**Correlation**	**Mexico**	**Canada**
Canada	**0.03**		**Canada**	**0.11**	
US	**-0.24**	**-0.10**	**US**	**0.05**	**-0.20**
Full Sample – Estimated with Δi_t					
4-LAG Model					
Correlation	Mexico	Canada	**Correlation**	Mexico	Canada
Canada	0.43		Canada	-0.50	
US	-0.20	0.70	US	-0.30	0.76
Average Full Sample for 4 and 6 Lags					
Correlation	**Mexico**	**Canada**	**Correlation**	**Mexico**	**Canada**
Canada	**0.40**		**Canada**	**-0.20**	
US	**-0.13**	**0.66**	**US**	**-0.15**	**0.80**
Average of the subsamples					
Correlation	**Mexico**	**Canada**	**Correlation**	**Mexico**	**Canada**
Canada	-0.01		**Canada**	-0.27	
US	-0.30	0.30	**US**	-0.21	0.31

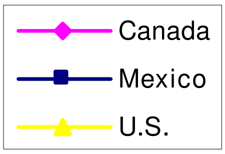


Figure 5: Correlation of Non cumulative Response to One S.D. Monetary Policy Innovation +/- 2 S.E. – Estimated with i_t

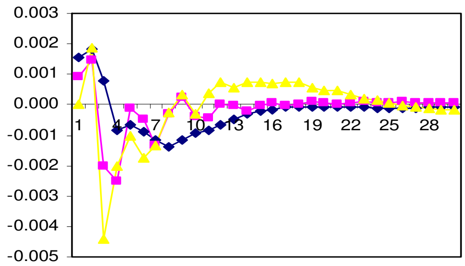
Output Growth	Inflation

Before Inflation Targeting

Four Lags

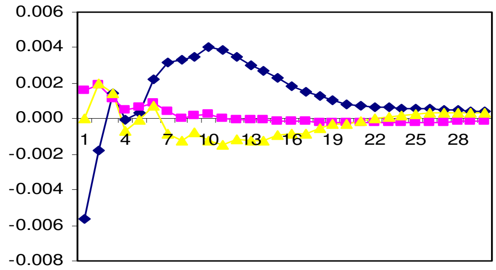
Output Growth

Correlation	Mexico	Canada
Canada	0.41	
US	0.10	0.81



Inflation

Correlation	Mexico	Canada
Canada	-0.58	
US	-0.57	0.65

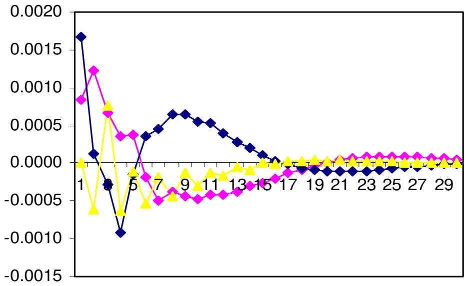


Inflation Targeting

Four Lags

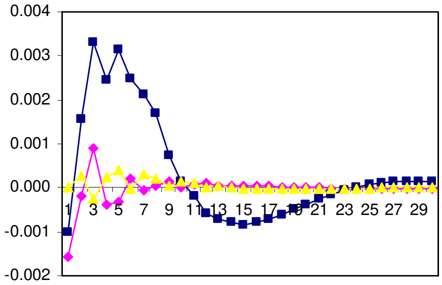
Output Growth

Correlation	Mexico	Canada
Canada	-0.12	
US	-0.08	0.04



Inflation

Correlation	Mexico	Canada
Canada	0.23	
US	0.42	-0.33

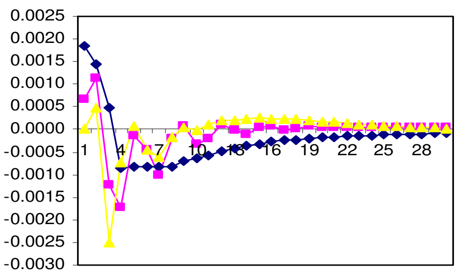


Full Period

Four Lags

Output Growth

Correlation	Mexico	Canada
Canada	0.55	
US	0.01	0.74



Inflation

Correlation	Mexico	Canada
Canada	-0.43	
US	-0.46	0.87

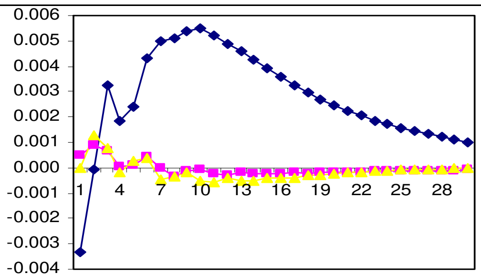


Table 5: Average Correlation under Assumption of Stationarity for Fund Rate.					
Correlation of Non cumulative Response to One S.D. Monetary Policy					
Innovation +/- 2 S.E. – Estimated with i_t					
			of		
Output Growth				**Inflation**	
Before Inflation Targeting					
Four Lags					
Correlation	**Mexico**	**Canada**	**Correlation**	**Mexico**	**Canada**
Canada	0.41		**Canada**	-0.58	
US	0.10	0.81	**US**	-0.57	0.65
Average Pre-Targeting Sample					
Correlation	**Mexico**	**Canada**	**Correlation**	**Mexico**	**Canada**
Canada	**0.31**		**Canada**	**-0.33**	
US	**-0.06**	**0.77**	**US**	**-0.63**	**0.42**
Targeting Sample					
Correlation	**Mexico**	**Canada**	**Correlation**	**Mexico**	**Canada**
Canada	-0.12		**Canada**	0.23	
US	-0.08	0.04	**US**	0.42	-0.33
Average Targeting Sample					
Correlation	**Mexico**	**Canada**	**Correlation**	**Mexico**	**Canada**
Canada	**-0.10**		**Canada**	**0.15**	
US	**-0.20**	**-0.05**	**US**	**0.47**	**-0.20**
Full Period					
Correlation	Mexico	Canada	Correlation	Mexico	Canada
Canada	0.55		Canada	-0.43	
US	0.01	0.74	US	-0.46	0.88
Average Full Sample					
Correlation	**Mexico**	**Canada**	**Correlation**	**Mexico**	**Canada**
Canada	**0.54**		**Canada**	**-0.30**	
US	**-0.08**	**0.70**	**US**	**-0.52**	**0.77**
Average of the subsamples					
Correlation	**Mexico**	**Canada**	**Correlation**	**Mexico**	**Canada**
Canada	0.11		**Canada**	-0.10	
US	-0.12	0.36	**US**	-0.08	0.12

Figure 6: Correlation of Non cumulative Response to One S.D. Monetary Policy Innovation

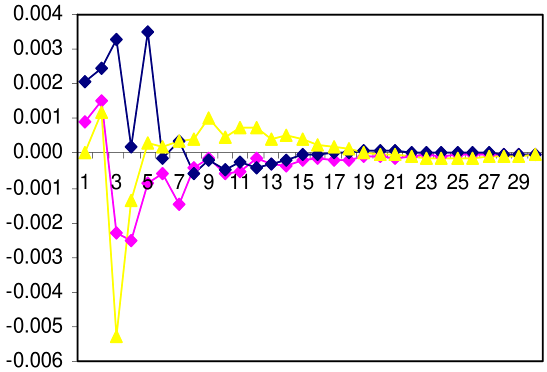
Output Growth	Inflation

Pre-targeting Sample – Estimated with Δi_t and US π_t

Four Lags

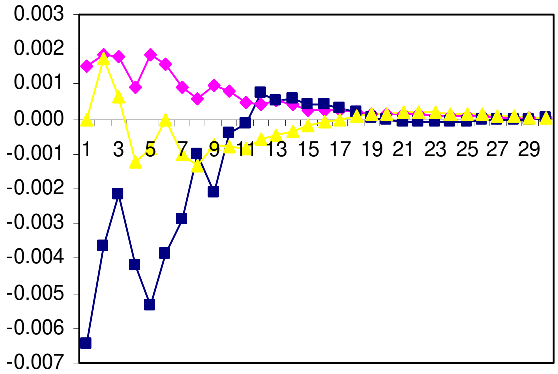
Output Growth

Correlation	Mexico	Canada
Canada	-0.05	
US	-0.45	0.62



Inflation

Correlation	Mexico	Canada
Canada	-0.85	
US	0.08	0.03

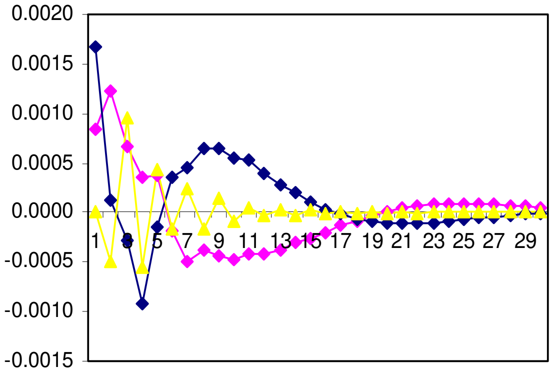


Inflation Targeting – Estimated with Δi_t and Mexico Δy_t

Four Lags

Output Growth

Correlation	Mexico	Canada
Canada	-0.14	
US	0.02	-0.02



Inflation

Correlation	Mexico	Canada
Canada	0.23	
US	-0.10	-0.51

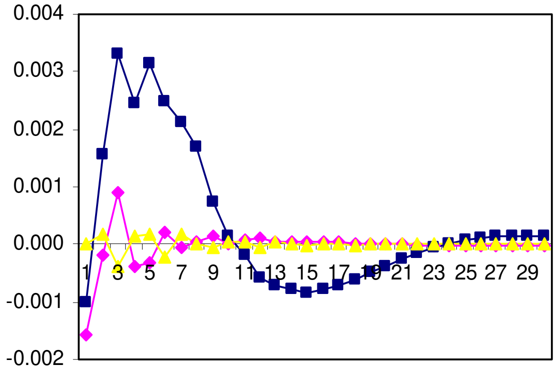


Table 6: Four Lag VAR Estimation – Estimated with Δi_t						
Pre-inflation Targeting Sample						
	Variance Decomposition of Output Growth			Variance Decomposition of Inflation		
	US Policy Shock	Supply Shock	Demand Shock	US Policy Shock	Supply Shock	Demand Shock
Canada						
1	1.20	98.80	0.00	9.55	8.94	81.51
5	16.30	76.98	6.72	29.75	7.72	62.52
10	17.99	72.51	9.50	34.70	6.64	58.66
30	18.48	71.72	9.79	35.53	6.41	58.07
Mexico						
1	5.43	94.57	0.00	2.99	1.86	95.15
5	20.32	70.29	9.39	7.15	11.87	80.98
10	20.08	68.84	11.08	7.21	11.97	80.82
30	20.18	68.73	11.09	7.21	11.97	80.82
Inflation Targeting Sample						
Canada						
1	4.71	95.29	0.00	9.54	0.08	90.39
5	13.36	77.90	8.74	12.03	0.55	87.42
10	16.21	74.05	9.73	12.14	0.70	87.16
30	18.75	71.53	9.72	12.21	0.71	87.07
Mexico						
1	2.35	97.65	0.00	0.25	38.40	61.35
5	1.09	98.21	0.69	4.87	50.89	44.24
10	2.29	96.82	0.88	7.38	49.39	43.23
30	6.78	91.99	1.23	8.63	49.40	41.96
Full Sample						
Canada						
1	1.12	98.88	0.00	0.66	2.46	96.88
5	10.88	85.27	3.86	7.26	2.71	90.02
10	12.25	80.84	6.91	9.48	3.97	86.55
30	12.40	80.44	7.16	9.55	4.11	86.35
Mexico						
1	3.06	96.94	0.00	2.66	9.09	88.25
5	6.56	88.46	4.99	2.44	17.79	79.77
10	6.62	88.29	5.09	2.66	19.80	77.54
30	6.62	88.28	5.10	2.72	20.13	77.15

Table 7: Four Lag VAR Estimation – Estimated with i_t						
Pre-inflation Targeting Sample						
	Variance Decomposition of Output Growth			Variance Decomposition of Inflation		
	US Policy Shock	Supply Shock	Demand Shock	US Policy Shock	Supply Shock	Demand Shock
Canada						
1	1.25	98.75	0.00	9.54	10.14	80.33
5	14.58	77.32	8.10	18.87	11.63	69.50
10	15.93	73.67	10.40	19.05	12.77	68.19
30	16.01	73.08	10.91	19.14	14.31	66.55
Mexico						
1	2.77	97.23	0.00	2.36	1.74	95.90
5	4.90	84.16	10.94	2.24	9.03	88.74
10	8.17	80.25	11.58	5.19	10.10	84.71
30	8.81	79.84	11.35	8.04	13.08	78.88
Inflation Targeting Sample						
Canada						
1	4.71	95.29	0.00	9.54	0.08	90.39
5	13.36	77.90	8.74	12.03	0.55	87.42
10	16.21	74.05	9.73	12.14	0.70	87.16
30	18.75	71.53	9.72	12.21	0.71	87.07
Mexico						
1	1.81	98.19	0.00	0.32	29.02	70.66
5	1.99	95.05	2.96	5.46	36.82	57.72
10	2.74	94.28	2.98	7.69	35.83	56.48
30	3.06	93.75	3.19	8.32	35.59	56.09
Full Period						
Canada						
1	0.97	99.03	0.00	0.97	2.49	96.54
5	10.66	83.81	5.53	3.89	2.77	93.34
10	12.09	79.00	8.91	4.36	2.74	92.90
30	12.16	78.54	9.30	5.84	2.93	91.23
Mexico						
1	2.56	97.44	0.00	1.31	8.54	90.15
5	4.28	91.84	3.88	2.13	17.10	80.77
10	5.94	90.24	3.82	9.56	16.57	73.87
30	6.67	89.47	3.87	17.86	15.23	66.91

Table 8 The Correlation of Output and Inflation Responses to US Monetary Policy and Oil Price Shocks Between Canada and the US

		Correlation of Responses to US Monetary Policy Shock		Correlation of Responses to Oil Price Shock	
		Output Growth	**Inflation**	**Output Growth**	**Inflation**
Estimation with 4 lags					
	1970-2008	0.71	0.42	0.67	0.91
	1970-1990	0.89	0.71	0.28	0.32
	1991-2008	0.51	0.63	0.52	0.74
		Output Gap	**Inflation**	**Output Gap**	**Inflation**
Estimation with 4 lags					
	1970-2008	0.69	0.64	0.50	0.83
	1970-1990	0.39	0.63	-0.34	0.35
	1991-2008	0.47	0.64	0.31	0.63

Table 9 Comparison of US-Canada and US-Mexico Correlation of Output and Inflation Responses to US Monetary Policy and Oil Price Shocks

		Correlation of Responses to US Monetary Policy Shock					**Correlation of Responses to Oil Price Shock**			
		Output Growth		**Inflation**		**Investment**	**Output Growth**		**Inflation**	
		Canada	**Mexico**	**Canada**	**Mexico**	**Canada and Mexico**	**Canada**	**Mexico**	**Canada**	**Mexico**
US-Canada VAR										
	4 Lags	0.76	0.15	0.47	0.39	0.00	0.71	0.19	0.91	-0.30
US-Mexico VAR										
	4 Lags	0.30	0.70	0.30	0.07	0.00	0.72	0.25	0.91	-0.38
		Output Gap		**Inflation**		**Investment**	**Output Gap**		**Inflation**	
		Canada	**Mexico**	**Canada**	**Mexico**	**Canada and Mexico**	**Canada**	**Mexico**	**Canada**	**Mexico**
US-Canada VAR										
	4 Lags	0.60	-0.44	0.30	0.26	0.26	0.72	0.16	0.87	0.22
US-Mexico VAR										
	4 Lags	0.38	0.20	-0.04	-0.19	0.26	0.72	0.16	0.85	0.15

Note: The values are correlations between each country's responses and the US own responses to US monetary policy shocks and oil price shocks. The values for Investment are the correlation between Canada's responses and Mexico responses to US monetary policy shocks. Since the US variables are incorporated in both Canada and Mexico VARs, correlations were computed using both sets of responses. Results are presented for the two measures of economic activity used: output growth and output gap.

Table 10 Variance Decomposition of Output Gap for Canada - Estimation with 4 Lags

	Proportion of Forecast Error in Canada's Output Gap Accounted for by Shocks to:							
		US			Canada			
Horizon	**Oil Prices**	**Output Gap**	**Inflation**	**Fund rate**	**Output Gap**	**Inflation**	**Bank rate**	**Investment**
1970-2008								
Lags								
1	3.0	1.0	8.0	**1.0**	1.0	86.0	**0.0**	0.0
5	10.0	14.0	9.0	**1.0**	4.0	57.0	**4.0**	0.0
10	8.0	27.0	9.0	**2.0**	5.0	42.0	**6.0**	1.0
30	9.0	30.0	10.0	**2.0**	4.0	34.0	**10.0**	1.0
1970-1990								
1	1.0	2.0	0.0	**14.0**	12.0	6.0	**0.0**	63.0
5	3.0	14.0	3.0	**12.0**	14.0	6.0	**6.0**	41.0
10	5.0	12.0	3.0	**11.0**	19.0	6.0	**6.0**	38.0
30	5.0	13.0	4.0	**11.0**	19.0	6.0	**6.0**	37.0
1991-2008								
1	0.0	5.0	0.0	**13.0**	83.0	0.0	**0.0**	0.0
5	2.0	12.0	35.0	**8.0**	30.0	9.0	**2.0**	2.0
10	4.0	10.0	41.0	**6.0**	26.0	7.0	**2.0**	2.0
30	6.0	11.0	38.0	**6.0**	27.0	7.0	**2.0**	2.0

Table 11 Variance Decomposition of Output for Canada - Estimation with 4 Lags

		Proportion of Forecast Error in Canada's Output Accounted for by Shocks to:							
			US			Canada			
	Horizon	**Oil Prices**	**Output**	**Inflation**	**Fundrate**	**Output**	**Inflation**	**Bankrate**	**Investment**
1970-2008									
	1	2.0	14.0	0.0	**0.0**	84.0	0.0	**0.0**	0.0
	5	3.0	16.0	1.0	**11.0**	59.0	2.0	**3.0**	5.0
	10	5.0	15.0	1.0	**13.0**	56.0	2.0	**3.0**	5.0
	30	5.0	15.0	1.0	**13.0**	55.0	2.0	**3.0**	5.0
1970-1990									
	1	3.0	14.0	0.0	**0.0**	83.0	0.0	**0.0**	0.0
	5	4.0	10.0	0.0	**20.0**	49.0	4.0	**1.0**	12.0
	10	6.0	11.0	2.0	**18.0**	45.0	4.0	**2.0**	11.0
	30	7.0	11.0	3.0	**18.0**	44.0	4.0	**2.0**	11.0
1991-2008									
	1	4.0	5.0	0.0	**14.0**	78.0	0.0	**0.0**	0.0
	5	16.0	15.0	7.0	**8.0**	36.0	5.0	**7.0**	6.0
	10	22.0	12.0	7.0	**8.0**	31.0	10.0	**6.0**	4.0
	30	26.0	11.0	7.0	**10.0**	26.0	11.0	**5.0**	4.0

Table 12 Variance Decomposition of Inflation for Canada based on the VAR with Output Gap – Estimation with 4 Lags

Proportion of Forecast Error in Canada's Inflation Accounted for by Shocks to:									
			US			Canada			
	Horizon	Oil Prices	Output Gap	Inflation	Fund rate	Output Gap	Inflation	Bank rate	Investment
1970-2008									
	1	11.0	0.0	9.0	0.0	3.0	77.0	0.0	0.0
	5	10.0	15.0	10.0	3.0	7.0	51.0	3.0	0.0
	10	16.0	14.0	7.0	4.0	9.0	42.0	5.0	2.0
	30	16.0	13.0	8.0	5.0	9.0	41.0	5.0	5.0
1970-1990									
	1	3.0	1.0	4.0	2.0	3.0	87.0	0.0	0.0
	5	7.0	14.0	9.0	4.0	3.0	51.0	12.0	1.0
	10	5.0	36.0	10.0	4.0	2.0	33.0	9.0	2.0
	30	4.0	35.0	9.0	3.0	4.0	27.0	10.0	7.0
1991-2008									
	1	26.0	0.0	15.0	0.0	1.0	57.0	0.0	0.0
	5	22.0	21.0	11.0	8.0	3.0	31.0	1.0	2.0
	10	24.0	21.0	9.0	9.0	3.0	28.0	3.0	3.0
	30	23.0	21.0	9.0	10.0	3.0	26.0	4.0	3.0

Table 13 Variance Decomposition of Inflation for Canada based on the VAR with Output – Estimation with 4 Lags

		Proportion of Forecast Error in Canada's Inflation Accounted for by Shocks to:							
			US			Canada			
	Horizon	Oil Prices	Output	Inflation	Fundrate	Output	Inflation	Bankrate	Investment
1970-2008									
	1	1.0	0.0	6.0	1.0	1.0	90.0	0.0	0.0
	5	9.0	7.0	13.0	2.0	5.0	59.0	2.0	3.0
	10	8.0	14.0	19.0	2.0	9.0	42.0	4.0	2.0
	30	7.0	21.0	21.0	2.0	8.0	30.0	6.0	4.0
1970-1990									
	1	1.0	0.0	5.0	2.0	0.0	92.0	0.0	0.0
	5	7.0	7.0	16.0	5.0	8.0	46.0	10.0	0.0
	10	7.0	17.0	26.0	4.0	8.0	28.0	9.0	0.0
	30	7.0	21.0	26.0	5.0	7.0	24.0	9.0	1.0
1991-2008									
	1	20.0	0.0	13.0	3.0	1.0	62.0	0.0	0.0
	5	25.0	18.0	9.0	16.0	1.0	26.0	1.0	3.0
	10	29.0	20.0	9.0	15.0	1.0	21.0	2.0	3.0
	30	29.0	18.0	10.0	15.0	3.0	20.0	2.0	4.0

Table 14 Variance Decomposition of Investment for Canada based on the VAR with Output Gap – Estimation with 4 Lags

		Proportion of Forecast Error in Canada's Investment Accounted for by Shocks to:							
			US			Canada			
	Horizon	**Oil Prices**	**Output Gap**	**Inflation**	**Fund rate**	**Output Gap**	**Inflation**	**Bank rate**	**Investment**
1970-2008									
	1	1.0	0.0	1.0	**1.0**	1.0	25.0	**5.0**	67.0
	5	14.0	7.0	11.0	**2.0**	11.0	14.0	**5.0**	36.0
	10	17.0	7.0	10.0	**4.0**	12.0	13.0	**6.0**	31.0
	30	17.0	6.0	10.0	**7.0**	12.0	13.0	**7.0**	28.0
1970-1990									
	1	1.0	2.0	0.0	**14.0**	12.0	6.0	**0.0**	63.0
	5	3.0	14.0	3.0	**12.0**	14.0	6.0	**6.0**	41.0
	10	5.0	12.0	3.0	**11.0**	19.0	6.0	**6.0**	38.0
	30	5.0	13.0	4.0	**11.0**	19.0	6.0	**6.0**	37.0
1991-2008									
	1	1.0	0.0	2.0	**5.0**	2.0	16.0	**0.0**	74.0
	5	6.0	4.0	19.0	**10.0**	16.0	14.0	**1.0**	31.0
	10	9.0	6.0	18.0	**8.0**	15.0	15.0	**3.0**	25.0
	30	11.0	7.0	18.0	**9.0**	15.0	15.0	**3.0**	22.0

Table 15 Variance Decomposition of Investment for Canada based on the VAR with Output – Estimation with 4 Lags

		Proportion of Forecast Error in Canada's Investment Accounted for by Shocks to:							
			US			Canada			
	Horizon	**Oil Prices**	**Output**	**Inflation**	**Fundrate**	**Output**	**Inflation**	**Bankrate**	**Investment**
1970-2008									
	1	0.0	1.0	0.0	**4.0**	13.0	4.0	**0.0**	78.0
	5	5.0	11.0	3.0	**8.0**	19.0	3.0	**5.0**	47.0
	10	5.0	11.0	3.0	**8.0**	20.0	3.0	**5.0**	46.0
	30	5.0	11.0	3.0	**8.0**	20.0	3.0	**5.0**	46.0
1970-1990									
	1	1.0	0.0	0.0	**8.0**	29.0	1.0	**0.0**	60.0
	5	7.0	8.0	5.0	**14.0**	25.0	2.0	**5.0**	34.0
	10	7.0	8.0	5.0	**13.0**	26.0	2.0	**6.0**	33.0
	30	7.0	9.0	6.0	**13.0**	26.0	2.0	**6.0**	32.0
1991-2008									
	1	0.0	0.0	1.0	**5.0**	3.0	7.0	**1.0**	83.0
	5	7.0	8.0	10.0	**16.0**	18.0	8.0	**1.0**	33.0
	10	10.0	8.0	10.0	**14.0**	18.0	11.0	**3.0**	28.0
	30	16.0	7.0	10.0	**13.0**	15.0	12.0	**3.0**	24.0

Table 16 Comparison of the Variance Decomposition of Investment between Canada and Mexico – Estimation with 4 Lags

	Proportion of Forecast Error in Mexico's Investment Accounted for by Shocks to:								Proportion of Forecast Error in Canada's Investment Accounted for by Shocks to:							
1981-2008		**US**			**Mexico**					**US**			**Canada**			
Horizon	**Oil Prices**	**Output gap**	**Inflation**	**Fund rate**	**Output gap**	**Inflation**	**interest rate**	**Investment**	**Oil Prices**	**Output gap**	**Inflation**	**Fund rate**	**Output gap**	**Inflation**	**Interest rate**	**Investment**
1	2.0	0.0	2.0	**0.0**	5.0	5.0	**5.0**	80.0	1.0	1.0	1.0	**1.0**	5.0	19.0	**4.0**	69.0
5	5.0	1.0	5.0	**5.0**	11.0	12.0	**4.0**	55.0	11.0	6.0	10.0	**4.0**	8.0	12.0	**5.0**	44.0
10	5.0	1.0	6.0	**4.0**	10.0	16.0	**5.0**	53.0	12.0	8.0	9.0	**5.0**	13.0	10.0	**5.0**	37.0
30	4.0	1.0	6.0	**4.0**	10.0	15.0	**5.0**	54.0	13.0	9.0	9.0	**6.0**	13.0	10.0	**5.0**	36.0
		US			**Mexico**					**US**			**Canada**			
	Oil Prices	**Output**	**Inflation**	**Fund rate**	**Output**	**Inflation**	**interest rate**	**Investment**	**Oil Prices**	**Output**	**Inflation**	**Fund rate**	**Output**	**Inflation**	**Interest rate**	**Investment**
1	1.0	0.0	2.0	**0.0**	5.0	5.0	**5.0**	81.0	1.0	1.0	1.0	**2.0**	3.0	15.0	**3.0**	73.0
5	6.0	0.0	5.0	**5.0**	12.0	11.0	**4.0**	57.0	10.0	9.0	10.0	**5.0**	11.0	10.0	**5.0**	41.0
10	5.0	1.0	5.0	**4.0**	11.0	16.0	**5.0**	54.0	13.0	8.0	10.0	**5.0**	11.0	9.0	**5.0**	39.0
30	5.0	1.0	6.0	**4.0**	11.0	14.0	**4.0**	55.0	13.0	8.0	10.0	**5.0**	11.0	9.0	**4.0**	39.0

Table 17 Comparison of the Variance Decomposition of Inflation between Canada and Mexico – Estimation with 4 Lags

	Proportion of Forecast Error in Mexico's Inflation Accounted for by Shocks to:								Proportion of Forecast Error in Canada's Inflation Accounted for by Shocks to:							
1981-2008		**US**			**Mexico**					**US**			**Canada**			
Horizon	**Oil Prices**	**Output gap**	**Inflation**	**Fund rate**	**Output gap**	**Inflation**	**Interest rate**	**Investment**	**Oil Prices**	**Output gap**	**Inflation**	**Fund rate**	**Output gap**	**Inflation**	**Interest rate**	**Investment**
1	0.0	1.0	0.0	**2.0**	3.0	95.0	**0.0**	0.0	6.0	1.0	11.0	**0.0**	1.0	82.0	**0.0**	0.0
5	1.0	1.0	1.0	**1.0**	3.0	84.0	**8.0**	1.0	6.0	12.0	9.0	**4.0**	5.0	58.0	**2.0**	4.0
10	1.0	1.0	3.0	**1.0**	3.0	80.0	**10.0**	1.0	6.0	14.0	8.0	**4.0**	10.0	50.0	**3.0**	4.0
30	1.0	2.0	3.0	**1.0**	3.0	79.0	**10.0**	1.0	7.0	14.0	9.0	**5.0**	10.0	49.0	**3.0**	4.0
		US			**Mexico**					**US**			**Canada**			
Horizon	**Oil Prices**	**Output**	**Inflation**	**Fund rate**	**Output**	**Inflation**	**Interest rate**	**Investment**	**Oil Prices**	**Output**	**Inflation**	**Fund rate**	**Output**	**Inflation**	**Interest rate**	**Investment**
1	0.0	0.0	0.0	**1.0**	5.0	93.0	**0.0**	0.0	8.0	0.0	12.0	**0.0**	2.0	77.0	**0.0**	0.0
5	0.0	1.0	2.0	**0.0**	6.0	81.0	**9.0**	1.0	12.0	10.0	12.0	**3.0**	2.0	55.0	**3.0**	4.0
10	1.0	1.0	4.0	**1.0**	7.0	74.0	**10.0**	1.0	11.0	12.0	11.0	**3.0**	3.0	52.0	**4.0**	4.0
30	2.0	1.0	5.0	**1.0**	8.0	72.0	**10.0**	2.0	11.0	12.0	11.0	**4.0**	3.0	51.0	**4.0**	5.0

Table 18 Comparison of the Variance Decomposition of Output Gap / Output between Canada and Mexico – Estimation with 4 Lags

		Proportion of Forecast Error in Mexico's Output Accounted for by Shocks to:									**Proportion of Forecast Error in Canada's Output Accounted for by Shocks to:**							
1981-2008			**US**			**Mexico**						**US**			**Canada**			
	Horizon	**Oil Prices**	**Output gap**	**Inflation**	**Fund rate**	**Output gap**	**Inflation**	**Interest rate**	**Investment**		**Oil Prices**	**Output gap**	**Inflation**	**Fund rate**	**Output gap**	**Inflation**	**Interest rate**	**Investment**
	1	2.0	5.0	0.0	0.0	93.0	0.0	0.0	0.0		4.0	16.0	1.0	0.0	79.0	0.0	0.0	0.0
	5	2.0	13.0	1.0	3.0	70.0	7.0	3.0	0.0		1.0	38.0	2.0	4.0	51.0	0.0	2.0	1.0
	10	2.0	13.0	1.0	4.0	65.0	11.0	3.0	0.0		5.0	34.0	7.0	8.0	42.0	1.0	2.0	1.0
	30	2.0	13.0	1.0	4.0	64.0	11.0	3.0	1.0		5.0	34.0	6.0	8.0	42.0	2.0	2.0	1.0
			US			**Mexico**						**US**			**Canada**			
	Horizon	**Oil Prices**	**Output**	**Inflation**	**Fund rate**	**Output**	**Inflation**	**Interest rate**	**Investment**		**Oil Prices**	**Output**	**Inflation**	**Fund rate**	**Output**	**Inflation**	**Interest rate**	**Investment**
	1	3.0	2.0	1.0	0.0	94.0	0.0	0.0	0.0		1.0	11.0	0.0	0.0	87.0	0.0	0.0	0.0
	5	7.0	4.0	4.0	1.0	72.0	6.0	5.0	2.0		13.0	19.0	12.0	4.0	43.0	1.0	5.0	4.0
	10	8.0	4.0	4.0	2.0	68.0	7.0	5.0	2.0		16.0	17.0	13.0	4.0	38.0	1.0	5.0	7.0
	30	8.0	4.0	4.0	2.0	67.0	7.0	5.0	3.0		17.0	17.0	13.0	4.0	37.0	1.0	5.0	7.0