Exchange Rate Pass-Through: Evidence from U. S. and Canada

انتقال سعر الصرف: أدلة من الولايات المتحدة الأمريكية وكندا

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Abstract

This paper investigates the degree of exchange rate pass-through (ERPT) to import prices, producer prices, and consumer prices in Canada and the United States using a Structural Vector Auto Regression (SVAR) model. While the overall scope of the study reflects economic developments through 2024, the empirical model is restricted to the period from 1980 to 2017. This cutoff is methodologically justified by the onset of significant global disruptions after 2017, including trade tensions, the COVID-19 pandemic, and the Russia–Ukraine war, which introduced structural breaks and heightened volatility in macroeconomic relationships.

The SVAR results indicate a positive long-run correlation between exchange rates and aggregate price levels. The impulse response function reveals a persistent and incomplete pass-through for exchange rate shocks—estimated at 0.20 for Canada and 0.27 for the United States. These results suggest that greater ERPT tends to occur in economies with more volatile monetary policy environments and higher inflation rates. Consistent with the impulse response analysis, variance decomposition reveals that exchange rate fluctuations explain a larger share of consumer price variation in the United States, whereas in Canada, import prices are more directly influenced by exchange rate movements. import prices are more directly influenced by exchange rate movements.

Keywords: Exchange rate pass-through; Import price index; Producer price index; Consumer price index; Structural vector autoregression (SVAR); Impulse response; Variance decomposition; Canada; U.S.

JEL Classification: C32, E31, E52, F31, F41

المستخلص

تبحث هذه الورقة البحثية في درجة انتقال سعر الصرف (ERPT) إلى أسعار الواردات، وأسعار المنتجين، وأسعار المستهلكين في كندا والولايات المتحدة الأمريكية باستخدام نموذج الانحدار التلقائي للمتجه الهيكلي .(SVAR) وبينما يعكس النطاق العام للدراسة التطورات الاقتصادية حتى عام ٢٠٢٤، فإن النموذج التجريبي يقتصر على الفترة من عام ١٩٨٠ إلى عام ٢٠١٧. ويُبرر هذا الحد الفاصل منهجيًا بظهور اضطرابات عالمية كبيرة بعد عام ٢٠١٧، بما في ذلك التوترات التجارية، وجائحة كوفيد–١٩، والحرب بين روسيا وأوكرانيا، التي أحدثت انكسارات هيكلية وزادت من تقلبات العلاقات الاقتصادية الكلية.تشير نتائج نموذج الانحدار التلقائي للمتجه الهيكلي إلى وجود علاقة إيجابية طويلة الأجل بين أسعار الصرف ومستويات الأسعار الكلية. وتكشف دالة الاستجابة النبضية عن انتقال مستمر وغير مكتمل لصدمات سعر الصرف – يُقدر بـ ٠.٢٠ لكندا و٠.٢٧ للولايات المتحدة. تشير هذه النتائج إلى أن معدل العائد على الاستثمار (ERPT) الأكبر يميل إلى الحدوث في الاقتصادات ذات بيئات السياسة النقدية الأكثر تقلبًا ومعدلات التضخم الأعلى. وتماشيًا مع تحليل الاستجابة النبضية، يكشف تحليل التباين أن تقلبات أسعار الصرف تُفسر نسبة أكبر من تباين أسعار المستهلك في الولايات المتحدة، بينما في كندا، تتأثر أسعار الواردات بشكل مباشر أكثر بتقلبات أسعار الصرف.

الكلمات المفتاحية: تمرير سعر الصرف؛ مؤشر أسعار الواردات؛ مؤشر أسعار المنتجين؛ مؤشر أسعار المستهلك؛ الانحدار الذاتي للمتجه الهيكلي(SVAR) ؛ الاستجابة النبضية؛ تحليل التباين؛ كندا؛ الولايات المتحدة

1. Introduction

Exchange rate prices pass-through have long piqued the interest of economists and policymakers. The exchange rate pass-through could be defined as the percentage change in local currency import prices resulting from a one percent change in the exchange rate between the exporting and importing countries (Goldberg and Knetter, 1997). A change in import prices affects retail and consumer prices. In an open economy such as Canada and the United States, exchange rate movements can have a material impact on prices, i.e., import, producer, and consumer prices. This is particularly important in the current context, with the depreciation of the Canadian dollar vis-à-vis the U.S. dollar.

Understanding exchange rate pass-through to prices is extremely important for several reasons. First, the degree and timing of exchange rate pass-through are essential for understanding inflation dynamics, which is a crucial issue for the central bank. Second, the degree of exchange rate pass-through affects the strength of the expenditure-switching effect, which is an important channel for the international transmission of country-specific shocks (An and Wang, 2011).

This study applies a Structural Vector Auto-Regression model (SVAR). It is a methodology that was firstly proposed by Sims (1980) to determine the proportion of the price level variance that can be explained by the changes in the exchange rate in Canada and the United States. The data used is from 1980: Q1 to 2017: Q3, and this is followed by an estimate of the pass-through rate for exchange rate movements.

The hypothesis underlying this study is that exchange rate shocks exert a statistically significant and measurable influence on domestic prices, though the degree of pass-through may vary depending on the price index considered and the time horizon observed. Within this framework, the study aims to shed light on how fluctuations in the exchange rate impact different levels of domestic prices in Canada, while also exploring the broader implications for inflation dynamics and the conduct of monetary policy. By examining this relationship, the research contributes to the ongoing debate on the stability of inflation targets in the face of external disturbances and the effectiveness of monetary responses.

To examine these relationships empirically, the study adopts a Structural Vector Auto-Regression (SVAR) model, a methodology first introduced by Sims (1980), which enables the identification of structural shocks and the analysis of dynamic interactions among key macroeconomic variables. The SVAR approach is particularly well-suited for investigating the transmission of exchange rate changes through the price system, as it allows for tracing the variance in price levels attributable to exchange rate movements, while accounting for the endogeneity of macroeconomic indicators.

The analysis relies on quarterly data for Canada and the United States, covering the period from the first quarter of 1980 to the third quarter of 2017. This extensive time span allows the study to capture both short-term dynamics and long-term structural patterns in the pass-through process. The estimated results provide insight into the magnitude and persistence of ERPT, offering valuable guidance for central banks concerned with inflation control and exchange rate volatility.

The remainder of the paper is structured as follows: Section Two presents a review of the relevant literature on exchange rate pass-through and price dynamics. Section Three introduces the data set and examines its key statistical properties. Section Four presents the empirical model and discusses the main findings, while Section Five concludes the study by summarizing the results and offering relevant policy recommendations.

2. Literature Review

Overall literature on exchange rate pass-through differentiates between direct and indirect channels that changes in the exchange rate can be forwarded to consumer prices. Sanusi (2010) assumes that the direct channel of movement in exchange rates on local prices is by prices of imported consumer goods or locally produced goods in foreign currency. The indirect channel is through prices of imported intermediate goods as currency fluctuations may influence production costs. Hyder and Shah (2004) also hold that the indirect exchange rate pass-through channel points to the competitiveness of goods in international markets. The depreciation of the exchange rate makes domestic goods cheaper for foreign buyers, and this is why exports and aggregate demand will rise and increase domestic prices.

The degree of pass-through falls within a wide range, from zero to complete pass-through. Yang (1997) states that the degree of pass-through is determined according to firms' behavior regarding the changes in the exchange rate. Firms usually choose between keeping the mark-ups unchanged and preserving the sales price level, otherwise balancing both alternatives. Furthermore, the degree and speed of exchange rate pass-through differ from one country to another depending on several factors. The literature argued that the country's size, exchange rate regime, degree of openness, and inflationary environment are the critical macroeconomic determinants influencing the exchange rate pass-through (Helmy, Fayed, & Hussien). An and Wang (2011) find that a more significant pass-through coefficient is associated with an economy with a smaller size, higher import share, more persistent and less volatile exchange rate, less stable monetary policy environment, higher inflation rate, and less volatile aggregate demand.

One strand of the literature analyses exchange rate pass-through to import price index (IMP), producer price index (PPI), and consumer price index (CPI) in a consistent framework, using vector autoregression (VAR) models. For example, Hahn (2003), Ito et al. (2005), Choudhri and Hakura (2006), and McCarthy (2007), among others. Such studies show that a significant proportion of imports is intermediate goods used to manufacture final consumption goods. Final goods also need to go through allocation processes before households consume them. IMP, PPI, and CPI partially reflect the prices of imports at various production and distribution stages. Authors have found that shocks to prices at an earlier stage of production and distribution are likely to affect prices at a later state and not the other way around. For example, they believe that shocks to IMP can affect PPI and CPI with one or more lags; at the same time, PPI and CPI shocks do not affect IMP directly. Contrarily, other studies, including Tandrayen-Ragoobur and Chicooree (2013) and Uddin, Quaosar, and Nandi (2014), discovered that the exchange rate pass-through to the consumer prices is most significant in Mauritius and Bangladesh, respectively.

Empirical research explores the size of the exchange rate pass-through in abundance, focusing on industrialized countries, specifically, the Euro area, the United States, and Japan. Surveys and discussions of the literature on the exchange rate pass-through are provided in Goldberg and Knetter (1997) and many others, including empirical studies such as McCarthy (2007), Gagnon and Ihrig (2004), Campa and Goldberg (2001), Choudhri and Hakura (2006), and Ito and Sato (2007), among others. Both the popular ordinary least squares (OLS) and vector autoregressive (VAR) approaches are used in estimation approaches. Collective clues can be summed up as follows. Number one, the degree and dynamics of exchange rate pass-through are incomplete, and the pass-through to import prices tends to be higher in magnitude and speed than consumer prices. In the second place, estimates across countries and studies for a particular country are significantly different and, at the time, conflicting. Third place, there was a general reduction degree of pass-through in the 1990s, mainly attributed to the low inflation environment in most industrialized countries.

Studies on the pass-through in developing countries are somewhat limited, although the few existing works show similar results as those of industrialized countries. For example, Chaoudhri and Hakura (2006) find zero elasticity of exchange rate pass-through to inflation in Bahrain, Singapore, Canada, and Finland. Regarding sub-Saharan Africa (SSA) countries, Kiptui et al. (2005), using a vector error correction approach, found incomplete pass-through in Kenya from 1972-2002. Their results show that an exchange rate shock leads to a sharp increase in inflation that evens out after four quarters, with the exchange rate accounting for 46 percent of inflation variance. Similarly, Chaoudhri and Hakura (2006) find an exchange rate pass-through of 0.09 for Kenya, including 0.14 for Ghana, 0.02 for South Africa, 0.06 for Zimbabwe, and 0.16 for Burkina Faso, and zero for Tunisia and Ethiopia.

3. The Data and Their Properties

The choice and order of the variables used in the SVAR are based on the various consideration. Since the study aims to capture the effects of exchange rate variations on import, producer, and consumer prices, the three prices, and exchange rates will be included in the model.

The paper adopts quarterly data covering the period 1980: Q1 to 2017: Q3. A detailed account of the data used, and the data sources are given in Table 1 in Appendix A. The oil price level is represented by a global price of Brent crude denominated in U.S. Dollars per barrel. The output gap is calculated by subtracting the potential GDP from the actual GDP. Furthermore, import prices, producer prices in manufacturing, and consumer prices are considered. Finally, the 3-Month or 90-day rates and yields; Interbank Rates are used to model monetary policy instruments and real exchange rates to control foreign and domestic price changes.

Although economic data are available beyond 2017, the study deliberately restricts the estimation period to the third quarter of 2017 to preserve the structural stability of the model. The post-2017 period witnessed a series of unprecedented events, including escalating trade tensions, particularly between the United States and China, and later the outbreak of COVID-19, all of which introduced substantial structural shocks into the global economy. Including these post-2017 data could compromise the reliability of the econometric model by violating the assumption of parameter constancy over time. Therefore, the choice to end the sample in 2017 ensures that the estimated relationships reflect a relatively stable economic environment, thereby reducing the risk of estimation bias or model misspecification.

3.1The Data Properties:

Unit root tests are performed to assess the data's time-series properties. The Augmented Dickey-Fuller (ADF) test results are summarized in Table 1. The test indicates that Exchange Rates ($reer_t$), Oil Prices (oil_t), Interest Rates (i_t), Import Prices Index (imp_t), Producer Prices Index (ppi_t), Gross Domestic Product (GDP_t), and Output Gap (gap_t) are integrated of order one, I (1), while the inflation (π_t) is a stationary series.

Table 1: Unit Root Test

Variables	Test Statistic			
	Canada		United States	
	Level	1st Difference	Level	1st Difference
Oil Prices	-1.542	-8.220	-1.542	-8.220
REER	-2.228	-9.781	-1.754	-9.659
Inflation	-4.627		-11.145	
Interest Rate	-1.756	-9.834	-2.008	-10.014
IMP	-1.316	-7.208	-1.216	-8.156
PPI	-0.918	-7.604	-0.337	-8.101
Output Gap	-2.104	-6.257	4.372	-6.749
GDP				

Note: Critical values for the test statistics are: –3.5 at 1%, –2.9 at 5%, and –2.6 at 10%

Estimating the Structural Vector Autoregressive (SVAR) requires establishing the order of the integration of the series involved and then selecting the optional lag length of the SVAR model. The lag length should be high enough to ensure that the errors are approximately white noise and small enough to allow estimation. The lag lengths are chosen by minimizing the Akaike Information Criterion (AIC). One lag of the first differenced series is used to estimate the SVAR model for Canada. At the same time, four lags are used to estimate the model for the United States. These lag lengths minimize the AIC of the SVAR.

Table 2: AIC for Different Lag Estimation of SVAR Model

Lags	Canada	USA
0	14.15	26.40
1	12.61*	25.80
2	12.96	25.85
3	13.08	26.04
4	12.88	25.62*

4. The Empirical Analysis

One of the main shortcomings of the unrestricted VAR (UVAR) approach is the difficulty of interpreting the impulse responses. This is because the choice of the Cholesky decomposition in the UVAR is not unique, given the number of alternative sets of orthogonalized impulse responses that can be obtained from any estimated VAR model. If we are going to perform impulse–response analyses, we ask, "What is the impact of a shock on one equation, keeping all the other shocks steady?" To analyze that impulse, we have to keep other shocks fixed. If error terms are associated, then a shock to one equation is related to shocks to other equations; a thought experiment of keeping all other shocks constant cannot be performed. The resolution is to write the errors as a linear combination of "structural" shocks.

Sim's (1980) own the approach of circumventing this problem by choosing an orthogonalization – typically imposing a causal ordering on the VAR. In the absence of such restrictions, the orthogonalized impulse responses are challenging to interpret, and the estimated model gives few meaningful insights into the economic system that it represents. The SVAR approach builds on Sim's approach. Still, it attempts to identify the impulse responses by imposing a priori restrictions on the covariance matrix of the structural errors and/or long-run impulse responses themselves, as suggested by Bwire et al. (2013).

4.1Methodology:

The structural VAR model is conducted to analyze the interrelationships between oil prices and overall price levels in Canada and the United States. The SVAR model depends on economic theory rather than Cholesky decomposition to recover structural innovations from residuals of reduced-form VAR. One likely drawback of the Cholesky approach is that in cases where the covariance between innovations is empirically non-zero, the disturbances' common component will be arbitrarily attributed to the first variable in the recursive VAR. This renders the reported impulse response functions (IRFs) and variance decompositions (VDs) susceptible to the ordering of the variable in the VAR. Such a VAR model has been criticized as devoid of economic content (Helmy et al., 2018).

The standard VAR model is specified as follows:

$$X_t = \theta + \Pi_1 X_{t-1} + \Pi_2 X_{t-2} + \ldots.. + \Pi_k X_{t-k} + \mathcal{E}_t \quad (1)$$

And, in matrix form following Hamilton, the SVAR model can be written as:

$$B_0 X_t = \beta_1 X_{t-1} + \beta_2 X_{t-2} + \ldots. + \beta_p X_{t-p} + \mu_t \quad (2)$$

Where X_t is a vector of n endogenous variables, θ is a vector of constants, Π_i are matrices of coefficients to be estimated, $\mathcal{E}_t$ is a white noise error term, the matrix β_0 is of order n*n and describes the contemporary relationships between the variables, and μ_t is the (unobserved) vector of structural shocks of order n*1. The white noise errors mean that the structural disturbances are serially uncorrelated such that $E|\mu_t \mu_t`| = D$, where D is a diagonal matrix.

By multiplying equation (2) by an inverse matrix β_0^{-1}, we obtained the reduced form of the VAR model of the dynamic structural model as in equation (3). It is noted that this adjustment is needed because the model given in equation (2) is not immediately observable, and structural shocks cannot be adequately identified.

$$X_t = \beta_0^{-1} (\beta_1 X_{t-1} + \beta_2 X_{t-2} + \ldots + \beta_p X_{t-p} + \mu_t) \quad (3)$$

Where μ_t is a n*1 vector of serially uncorrelated structural disturbances of the model and is obtained as follows:

$$\mathcal{E}_t = \beta_0^{-1} \mu_t \quad (4)$$

To estimate an SVAR model and get the impulse response functions (IRFs) and variance decompositions (VDs), you need to use structural shocks, μ_t, and not the forecast errors, $\mathcal{E}_t$. These innovations include a linear combination of serially independent structural shocks, μ_t. So, the whole idea of structural decomposition is to take the observed values of $\mathcal{E}_t$ from an empirical VAR and restrict the system to recover μ_t (Helmy et al., 2018).

The variance-covariance matrix is given by:

$$E|\mathcal{E}_t \mathcal{E}_t`| = \beta_0^{-1} E|\mu_t \mu_t`|(\beta_0^{-1})` = \beta_0^{-1} D(\beta_0^{-1})` = \Omega \quad (5)$$

Cholesky decomposition of the variance-covariance matrix of the reduced form VAR residuals `Ω is used to create structural shocks. Because the inference of the SVAR model has K^2 more parameters than the VAR, to come up with a unique solution, both the order condition and the rank condition are needed to be satisfied. The order condition requires that several matrices β0 and D parameters are less than the number of free parameters in the matrix Ω. Since Ω is a symmetric matrix, the number of free parameters of the matrix Ω is defined by the k(k+1)/2, where k represents the number of endogenous variables incorporated into the system.

If D is a diagonal matrix, then β_0 can have no more free parameters than k(k-1)/2. Two different restrictions on matrix β_0 can be imposed. The first is the normalization restriction that aims to assign the value of 1 to variables $X_{t,j}$ in each of the i^{th} equation. And the second is the exclusion restriction, which aims to assign zero to some variables in the equation. These restrictions are defined by the theoretical model (Bwire et al., 2013).

4.2The Baseline Model:

The data used in the SVAR model consists of quarterly observations, covering the period from 1980: Q1 to 2017: Q3. Referring to the variable of interest for our analysis and taking into account their unit root properties, the variables included in the model are the first difference of the log of oil prices (Δoil_t) that is used to capture supply shocks, interest rate (Δi_t) is included to allow for potential effects of monetary policy, output gap (Δgap_t) or gross domestic product (ΔGDP_t) is used to capture demand shocks, exchange rate ($\Delta reer_t$), import prices index (Δimp_t), producer prices index (Δppi_t), and the level of the Inflation (π_t).

The ordering of the variables is indicated by the vector of endogenous variables $X_t = (\Delta oil_t, \Delta i_t, \Delta gap_t, \Delta reer_t, \Delta imp_t, \Delta ppi_t, \pi_t)$. Imposing the restrictions suggested by the theoretical model and using this ordering in the Cholesky decomposition, the relationship between the error terms of the reduced-formed VAR, $\mathcal{E}_t$, and the structural disturbances (shocks), μ_t, of the model can be specified as follows.

$$\mathcal{E}_t^{oil} = 1\ \mu_t^{oil}$$

$$\mathcal{E}_t^{i} = \alpha_{21}\ \mu_t^{oil} + 1\ \mu_t^{i}$$

$$\mathcal{E}_t^{gap} = \alpha_{31}\ \mu_t^{oil} + \alpha_{32}\ \mu_t^{i} + 1\ \mu_t^{gap}$$

$$\mathcal{E}_t^{reer} = \alpha_{41}\ \mu_t^{oil} + \alpha_{42}\ \mu_t^{i} + \alpha_{43}\ \mu_t^{gap} + 1\ \mu_t^{reer}$$

$$\mathcal{E}_t^{imp} = \alpha_{51}\ \mu_t^{oil} + \alpha_{52}\ \mu_t^{i} + \alpha_{53}\ \mu_t^{gap} + \alpha_{54}\ \mu_t^{reer} + 1\ \mu_t^{imp}$$

$$\mathcal{E}_t^{ppi} = \alpha_{61}\ \mu_t^{oil} + \alpha_{62}\ \mu_t^{i} + \alpha_{63}\ \mu_t^{gap} + \alpha_{64}\ \mu_t^{reer} + \alpha_{65}\ \mu_t^{imp} + 1\ \mu_t^{ppi}$$

$$\varepsilon_t^{\pi} = \alpha_{71}\, \mu_t^{oil} + \alpha_{72}\, \mu_t^{i} + \alpha_{73}\, \mu_t^{gap} + \alpha_{74}\, \mu_t^{reer} + \alpha_{75}\, \mu_t^{imp} + \alpha_{76}\, \mu_t^{ppi} + 1\, \mu_t^{\pi}$$

Identification of the structural shock (μ_t) is obtained by appropriately ordering the seven variables of interest and applying Cholesky decomposition to the variance matrix of the reduced-form residuals (ε_t). In this case, it is essential to set the order of the variables. The oil price shock is ordered first, as no factor affects the oil price except its own supply, influencing other variables (Ito & Sato, 2006). Following an oil price shock, a change in the interest rate captures monetary shocks. Ordering monetary policy shock second allows it to affect the output gap and exchange rate in a country (Saha & Zhang, 2013). Next, the exchange rate shock is set after the output gap to respond to the demand shock (output gap shock). Finally, following the literature on distribution chains, the price levels (imp, ppi, & cpi) are put last in the order.

5. The Empirical Results:

5.1. Impulse Response Function of Exchange Rate Shock for Canada and United States:

Understanding exchange rate pass-through to prices is extremely important for several reasons. First, the degree and timing of exchange rate pass-through are important for understanding inflation dynamics, which is a key issue for central banks. Second, the degree of exchange rate pass-through affects the strength of the expenditure-switching effect, which is an important channel for the international transmission of country-specific shocks.

Figure 1 shows the impact of one standard deviation shock, defined as exogenous, unexpected, or temporary in the exchange rate with a 95 percent confidence level on the pricing chain (import prices, producer prices, and consumer prices) in Canada and the United States. The solid line is the estimated response, while the dashed lines denote a two-standard error confidence band around the estimate.

Figure 1: Impulse Response Function of REER Shock

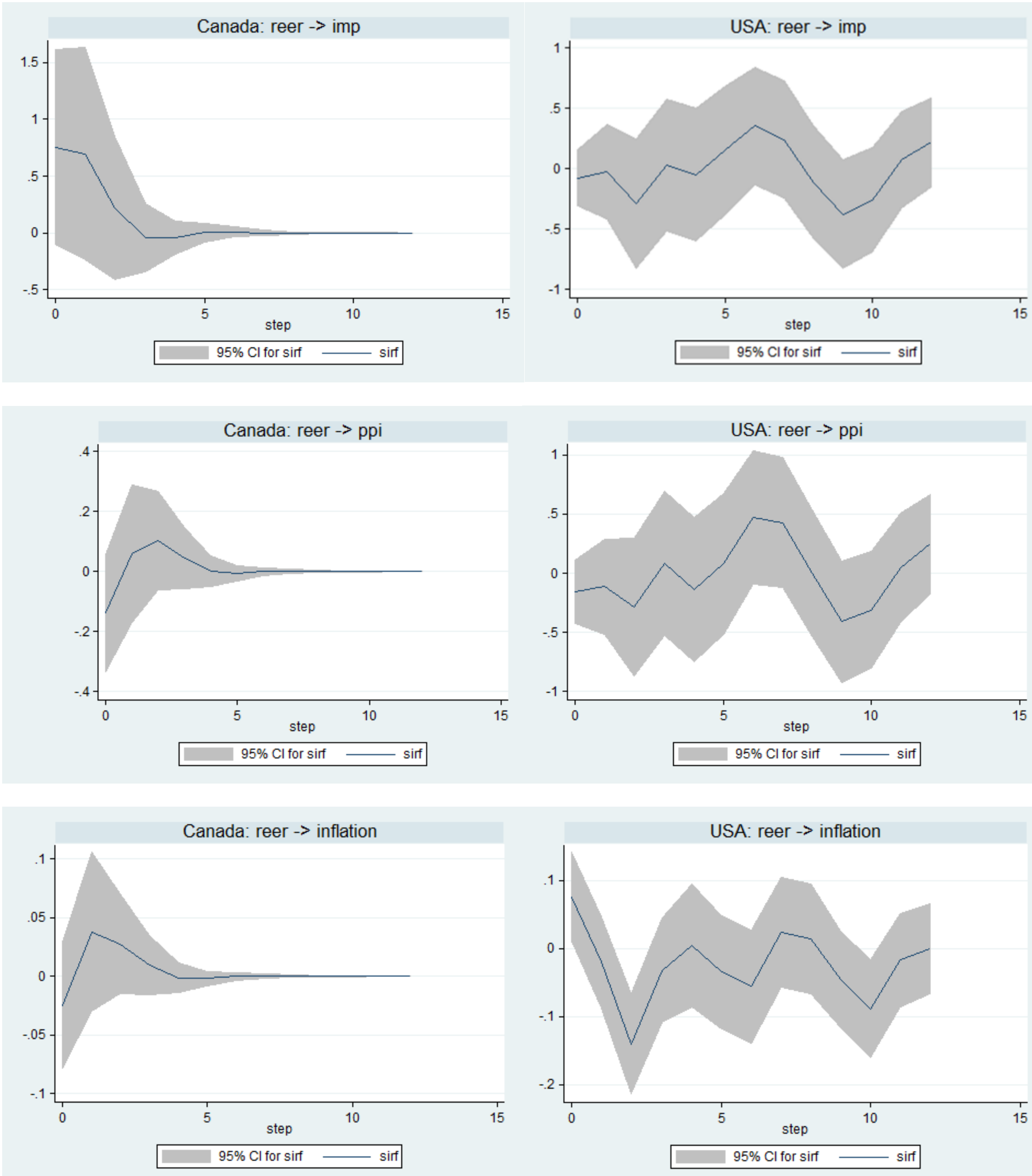


Table 3: Impulse Response Function of REER Shock						
	Canada			United States		
Step	IMP	PPI	CPI	IMP	PPI	CPI
0	0.754	-0.139	-0.025	-0.075	-0.155	0.076
1	0.697	0.060	0.038	-0.023	-0.111	-0.020
2	0.217	0.103	0.028	-0.288	-0.288	-0.141
3	-0.042	0.044	0.010	0.032	0.084	-0.033
4	-0.045	0.001	0	-0.048	-0.138	0.005
5	0.003	-0.005	0	0.153	0.081	-0.035
6	0.010	0	0	0.354	0.472	-0.056
7	0	0	0	0.242	0.428	0.024
8	0	0	0	-0.112	-0.001	0.014
9	0	0	0	-0.375	-0.410	-0.046
10	0	0	0	-0.260	-0.311	-0.088
11	0	0	0	0.078	0.050	-0.017
12	0	0	0	0.217	0.246	0

Figure 2: Canada (reer shock)

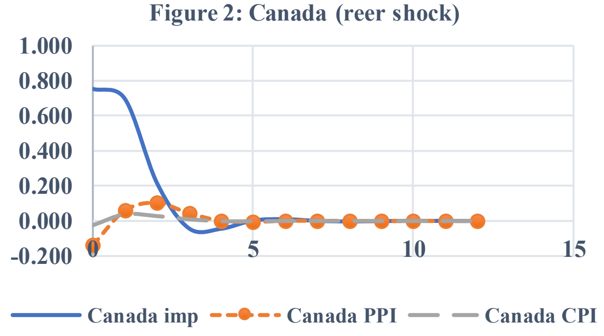
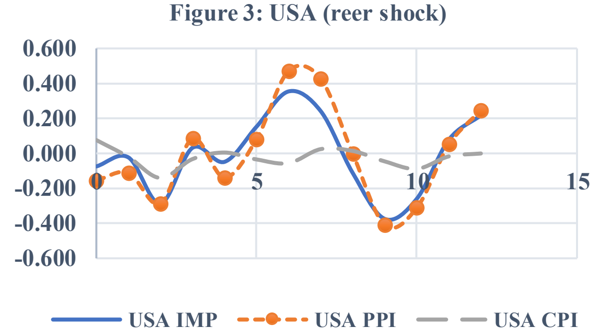


Figure 3: USA (reer shock)



It is clear from figure 1 that the effect of exchange rate shock on import prices and producer prices is immediately negative, while it is an immediate positive effect on consumer prices from the first quarter of the United States. Based on the numbers in Table 3, the direct impact of a structural one standard deviation shock of exchange rate shock in the U.S. is about 0.075 decrease in the import prices level, 0.155 decreases in the producer prices level, and 0.076 increase in the consumer prices level (almost negligible: take time to have an impact on CPI). However, in Canada, the effect of exchange rate shock on import prices is an immediate positive effect from the first quarter and an adverse effect on producer and consumer prices. Based on the numbers in Table 3, the immediate impact of a structural one standard deviation shock of exchange rate shock in Canada is about

0.75 increase in the import price level, 0.14 (or 14%) decrease in the producer prices level, and 0.025 decreases in the consumer price level.

Changes in the currency's external value have direct and indirect effects on prices. Consider, for example, the effects associated with an appreciation of the domestic currency (U.S. dollar). The direct impact work through two main channels of transmission. First, prices of finished goods imported into the country become less expensive due to the increased purchasing power of the domestic currency. Each dollar buys more foreign currency. This change in the dollar's relative value effectively lowers the dollar price that U.S. importers pay for items purchased from other countries. Second, the prices of imported inputs used in the domestic production of goods also become less expensive. And that explains the decrease in the import prices in the United States. However, this decrease will not happen in Canada, where we have a different case. Contrary to widespread belief in Canada, when the value of the Lonnie increases, the import prices will rise. This can be explained as follows; there is a relationship between oil prices and the importance of the Canadian currency: when the oil prices increase, the Lonnie value will increase.

The decrease in the import prices will decrease the production costs of domestic producers, who may subsequently pass on these lower costs to consumers via lower prices in the United States and Canada. However, the timing and magnitude of the total direct effect of ERPTH on consumer prices are in doubt and depend on various factors, including the rate of pass-through to import prices, the proportion of imports in the consumption basket, and demand conditions, the cost of changing prices and perceptions of the duration of the appreciation. Notice also that prices for services are generally relatively insensitive to direct ERPTH as they are pretty much domestically targeted and hence less subject to price pressures flowing from the lower import costs.

Oil is priced in U.S. dollars on the world market, so oil prices correlate strongly with the dollar's value. Oil has perennially been the most significant U.S. import, accounting for 10.5 percent of the dollar value of all imports in 2014. In 2015, oil dropped from the top spot, shrinking 4.5 percent as a result of dropping global oil prices and a declining volume the total imports. Altogether, import oil prices dropped 43.7 percent, and volumes of imports fell by 9.7 percent in 2015. The strong U.S. dollar helped push West Texas Intermediate (WTI) oil prices down to $37.13 a barrel on December 31; the price represented a 30-percent drop from 2014. Oil prices decreased in 2015 by other factors, such as an increase in global oil production and enhanced hydraulic fracturing in the United States (Reed K., 2016).

Exchange rate pass-through can also indirectly affect consumer prices through changes in the composition of demand and the levels of aggregate demand and wages. Following an appreciation in the currency, demand for domestic goods falls at home and abroad. This is because lower prices for imported goods decrease demand for domestically produced substitutes, while high prices for domestic exports, in turn, decrease foreign demand for such goods. Lower demand for domestic goods puts additional pressure on domestic prices. Finally, the decrease in demand for domestic goods will eventually lead to lower labor demand and thus lower wages, which could also be reflected in lower prices.

5.2. Estimation of Pass-Through rates of Exchange Rate Shocks in Canada and United States:

The exchange rate pass-through could be defined as the percentage change in local currency import prices resulting from a one percent change in the exchange rate between the exporting and importing countries (Goldberg and Knetter, 1997). A change in import prices affects retail and consumer prices. When the exchange rate pass-through is more remarkable, there is more transmission of inflation between countries. Exchange rate pass-through is also related to the law of one price and purchasing power parity (Campa and Goldberg, 2001).

Exchange rate pass-through has thus been considered an essential macroeconomic instrument that could help ensure low inflation rate levels and a stable financial system.

This section describes the data and the methodology used to estimate the exchange rate pass-through to consumer prices. A separate sample for each country is used from 1980: Q1 to 2017: Q3.

For each country, the following pass-through equation is estimated:

$$\Delta CPI = \delta_0 + \delta_1\ \Delta CPI_{t-1} + \delta_2\ \Delta\ (reer + FCPI) + \delta_3\ \Delta\ (reer_{t-1} + FCPI_{t-1}) + \delta_4\ \Delta\ (reer_{t-2} + FCPI_{t-2})$$

The variables CPI, reer, and FCPI are the quarterly consumer price index, real effective exchange rate, and foreign consumer price index, respectively. The coefficients δ2, δ3, and δ4 represent the immediate, one-quarter lag, and two-quarter lag impact of an exchange rate change or foreign price level change on the consumer price level, respectively. The equation incorporates lagged adjustment of inflation to shocks so that $(\delta_2 + \delta_3 + \delta_4)/(1-\delta 1)$ measures the long-run pass-through of exchange rate movements to overall inflation.

Table 4: The Long-Run Rates of Exchange Rate Pass-Through	
Country	Exchange Rate Pass-Through
Canada	0.20
USA	0.27
Source: Authors’ calculations based on the outcomes of the SVAR model	

Table 4 reports each country's regression of the long-run rates of exchange rate pass-through for the entire period. The pass-through estimates are incomplete (less than one) for Canada and United States. Incomplete pass-through indicates that consumer prices increase less than the depreciation of the exchange rate.

The pass-through rate range is between zero and one. When the pass-through equal one, that implies producer currency pricing and full pass-through, and when the pass-through equal zero, that implies local currency pricing and zero pass-through (Sutherland, 2005).

In theory, at least two potential reasons for pass-through ratios being greater than one (An and Wang, 2011). First, the decline of import demand caused by the depreciation of the importer's currency can increase the producer's cost in the case of increasing returns to scale. As a result, import prices can grow more than the depreciation of the exchange rate. Second, exchange rate pass-through also depends on the demand elasticity. Suppose the elasticity declines with output and the optimal markup charged by monopolistic supplier increases following a depreciation of the importer's currency. As a result, the exchange rate pass-through ratio can be greater than one. Also, recent theoretical work has suggested several potentially essential factors causing incomplete pass-through of exchange rates to prices, including markup adjustment, local costs, and barriers to price adjustment (Nakamura and Zerom, 2009).

The degree of exchange rate pass-through for Canada is less than the U.S., where the long-run rate of exchange rate pass-through for Canada is 0.20, suggesting that, on average, a one percent depreciation in the local currency value causes consumer prices to rise by 20% in the long-run, while in the U.S. The long run of exchange rate pass-through is 0.27, suggesting that on average, a one percent depreciation in the local currency value causes consumer prices to rise by 27% in the long-run, and a low-inflation environment can explain that one that is caused by a change in monetary policy, causes a drop in degree of pass-through of currency fluctuations to consumer prices in Canada.

5.3. Variance Decomposition:

Table 5: Variance Decomposition for U.S.

Impulse	Response		Response		Response	
Oil Prices	IMP	0.61	PPI	0.53	CPI	0.04
Interest Rate	IMP	0	PPI	0	CPI	0.01
Output Gap	IMP	0	PPI	0.01	CPI	0.02
REER	IMP	0	PPI	0	CPI	0.07
IMP	IMP	0.39	PPI	0.27	CPI	0.02
PPI	IMP	0	PPI	0.19	CPI	0

CPI	IMP	0	PPI	0	CPI	0.84
Total		1		1		1

The variance decomposition of the SVAR model is shown in Table 5 to analyze further the transmission channels of pass-through rates of exchange rate for U.S. Import prices explain 27% of the variation in producer prices, and its own shock explains 19% of the variation in producer prices. These results support that the direct exchange rate pass-through channel (i.e., import price changes to producer prices) is stronger than the indirect channel (i.e., exchange rate changes to producer prices) in the U.S.

Moreover, the consumer price shocks explain 84% of its variation, which indicates that the own price (CPI) shocks are the key to describing its variation. Concerning the variance of CPI, exchange rate shocks seem more noticeable than oil prices shock, and import prices change in explaining the variation in CPI. The exchange rate shocks account for 7% of the variation in CPI against 4% explained by oil price shocks and 2% explained by import price changes over 12 quarters. Hence, the findings suggest that the indirect exchange rate pass-through channel of changes in exchange rates to consumer prices is more pronounced than another direct channel in the U.S.

Table 6: Variance Decomposition for Canada

Impulse	Response		Response		Response	
Oil Prices	IMP	0.02	PPI	0.04	CPI	0.06
Interest Rate	IMP	0	PPI	0	CPI	0.01
Output Gap	IMP	0.02	PPI	0.02	CPI	0.13
REER	IMP	0.03	PPI	0.02	CPI	0.01
IMP	IMP	0.93	PPI	0	CPI	0
PPI	IMP	0	PPI	0.93	CPI	0
CPI	IMP	0	PPI	0	CPI	0.79
Total		1		1		1

The variance decomposition of the SVAR model is shown in Table 6 to analyze further the transmission channels of pass-through rates of exchange rate for Canada.93% of the variation in import prices is explained by its own shock. Oil price shocks account for 4% of the variation in producer prices, output gap and exchange rate shocks explain

2% of the variation in producer prices for each, and 93% of the variation in producer prices is explained by its own shocks. These results support that the indirect exchange rate pass-through channel (i.e., exchange rate changes to producer prices) is stronger than the direct channel (i.e., import prices change to producer prices) in Canada.

Moreover, the consumer price shocks explain 79% of its variation, which indicates that the own price (CPI) shocks are the most important in explaining its variation. Exchange rate and interest rate shocks account for 1% of the variation in consumer prices for each. Consequently, the findings suggest that the indirect exchange rate pass-through channel of changes in the exchange rate to consumer prices is more evident than another direct channel in Canada.

6. Post-2017 Macroeconomic Shocks and the Evolution of Exchange Rate Pass-Through (2018–2024)

significantly influenced the behavior and volatility of exchange rate pass-through (ERPT) to consumer prices (CPI). These disruptions include the escalation of U.S.–China trade tensions (2018–2019), the COVID-19 pandemic and its global economic fallout (2020–2022), widespread supply chain breakdowns, the global surge in shipping and energy costs, and the far-reaching geopolitical effects of the Russia–Ukraine war since early 2022. Each of these developments has intensified volatility in exchange rates, inflation dynamics, and cross-border pricing behavior.

In **2018**, the initiation of the U.S.–China trade war introduced considerable uncertainty in global markets, increasing input costs and altering firms' pricing strategies. According to the Bank for International Settlements (BIS, 2018), this uncertainty resulted in modest increases in ERPT, especially in open economies where rising import tariffs contributed to cost-push inflation.

In **2019**, although trade tensions persisted, markets began adjusting to new tariff structures. Empirical studies, including those by the IMF (2020), estimated ERPT to

CPI in advanced economies to be between **0.20 and 0.25**, reflecting the buffering role of inflation-targeting monetary frameworks and relative price stability.

The year **2020** marked a major structural break as the COVID-19 pandemic led to synchronized global lockdowns and a collapse in aggregate demand. Inflationary pressures diminished in the early stages, and ERPT declined accordingly. IMF (2021) data revealed that ERPT in the United States dropped to around **0.22**, driven by deflationary tendencies and delayed pricing adjustments in a context of unprecedented uncertainty.

By **2021**, ERPT began to rise again as global energy prices surged and supply chain frictions intensified. The World Bank (2022) reported that import-dependent economies saw ERPT estimates climb to **0.24–0.28**, particularly in sectors sensitive to food and fuel prices.

In **2022**, the Russia–Ukraine conflict further strained global commodity markets, exacerbating energy price shocks. The OECD (2023) noted that ERPT approached **0.30** in countries with weaker monetary policy anchors or heavy import reliance, as global inflation accelerated and exchange rate movements became more impactful.

During **2023**, as central banks such as the U.S. Federal Reserve and the Bank of Canada transitioned toward aggressive monetary tightening to contain inflation, ERPT remained volatile but somewhat more predictable. Updated figures from the IMF (2023) and OECD (2024) estimated ERPT in the U.S. within the range of **0.25–0.30**, and in Canada between **0.18–0.22**, signaling that monetary credibility helped contain further pass-through escalation despite persistent global supply constraints.

Preliminary assessments for **2024** indicate that ERPT remains elevated compared to pre-pandemic levels, although global inflation has begun to decelerate. OECD (2024) estimates place ERPT to CPI at around **0.26–0.29**, particularly in economies still facing commodity-driven cost pressures and lingering structural bottlenecks.

Overall, these post-2017 developments highlight that ERPT has become more volatile, nonlinear, and increasingly influenced by global shocks, such as geopolitical risks and supply disruptions. Traditional linear models of pass-through may no longer suffice, underscoring the need for advanced empirical frameworks—such as time-varying parameter models and threshold VARs—that account for regime shifts and structural breaks. Although this study confines its analysis to the 1980–2017 period for methodological consistency, the post-2017 evidence provides a compelling rationale for extending future research to capture the evolving and dynamic nature of exchange rate transmission mechanisms in the contemporary global economy.

6. Conclusion

Using a Structural Vector Auto-Regression model, this paper estimates exchange rate pass-through to import prices, producer prices, and consumer prices for both Canada and United States. The partial exchange rate pass-through for Canada and United States is supported by results, where the exchange rate pass-through for Canada is 0.20 and for the United States is 0.27. Also, the magnitudes of pass-through ratios are broadly in line with previous literature. The extent of exchange rate pass-through did not decline along the pricing chain. Exchange rate pass-through ratios of import, producer, and consumer prices are 0.754, -0.139, and -0.025, respectively for Canada, while for the United States, the ratios are -0.075, -0.155, and 0.076, respectively. Moreover, from the variance decomposition results, exchange rate shocks have more impact on consumer prices in the U.S. However, in the opposite case in Canada, the exchange rate shocks have more impact on import prices. Furthermore, it is found that a more significant pass-through coefficient is associated with an economy with a higher import share, more persistent and less volatile exchange rate, less stable monetary policy environment, and higher inflation rate. To conclude, exchange rate shocks significantly impact consumer prices in the U.S. However, in Canada, the exchange rate shocks seem to have more impact on import prices.

7. Recommendations

In light of the empirical findings of this study, several policy and research recommendations can be drawn:

First, the evidence of partial exchange rate pass-through in both Canada and the United States suggests that monetary authorities should not assume full transmission of exchange rate fluctuations to domestic prices. This has important implications for inflation targeting frameworks, particularly in Canada where the exchange rate pass-through to consumer prices is weak. Central banks should therefore complement exchange rate monitoring with direct measures of domestic inflationary pressures when setting interest rates.

Second, since exchange rate shocks appear to have a greater impact on consumer prices in the U.S., policymakers there should pay closer attention to exchange rate volatility when designing inflation control strategies. In contrast, the stronger impact of exchange rate shocks on import prices in Canada highlights the importance of enhancing trade competitiveness and diversifying import sources to mitigate vulnerability to exchange rate movements.

Third, the results suggest that higher pass-through rates are associated with economies characterized by higher import dependency, persistent exchange rate changes, inflationary environments, and less credible monetary policy frameworks. This calls for a strengthening of macroeconomic fundamentals, particularly in economies with weaker monetary credibility, through the reinforcement of inflation-targeting regimes, improvement in central bank transparency, and reduction in structural inflationary pressures.

Fourth, given the negative or weak pass-through to producer and consumer prices in both countries, further research should explore the role of price rigidities, market structures, and the strategic behavior of firms in pricing decisions. This would help clarify why the transmission of exchange rate changes diminishes along the pricing chain, particularly in Canada.

Finally, from a methodological standpoint, future research may benefit from extending the SVAR model to incorporate non-linear dynamics, structural breaks, or asymmetries in the pass-through mechanism. In addition, further comparative studies across other open economies may provide valuable insights into how institutional quality, exchange rate regimes, and fiscal policy coordination influence ERPT.

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Appendix A:

Table 1: Data sources and Description

Variable	Description	Source
Oil Price	Global price of Brent Crude, U.S. Dollars per barrel, Quarterly, Not Seasonally Adjusted	International Monetary Fund (IMF)
Exchange Rate	Real Effective Exchange Rates Based on Manufacturing Consumer Price Index, Index 2010=1, Quarterly, Not Seasonally Adjusted	Organization for Economic Co-operation and Development (OECD)
Consumer Prices Index	Consumer Price Index of All Items, Index 2010=100, Quarterly, Not Seasonally Adjusted	Organization for Economic Co-operation and Development (OECD)
Interest Rate	3-Month or 90-day Rates and Yields: Interbank Rates, Percent, Quarterly, Not Seasonally Adjusted	Organization for Economic Co-operation and Development (OECD)
Import Price Index	Import Price Index: All commodities, Index 2000=100, Quarterly, Not Seasonally Adjusted	U. S. Bureau of Labor Statistics
Producer Prices Index	Producer Prices Index: Index 2010=1, Quarterly, Not Seasonally Adjusted	Organization for Economic Co-operation and Development (OECD)
GDP	Gross Domestic Product, Quarterly, Seasonally Adjusted	U. S. Bureau of Labor Statistics
Output Gap	Calculate as following: Output Gap = Actual GDP – Potential GDP.	
Foreign Consumer Prices Index	FCPI for Canada = (90% CPI USA + 4% CPI China + 3% CPI UK+ 2% CPI Japan+ 1% CPI Mexico). FCPI for USA = (30% CPI China + 26% CPI Mexico + 27% CPI Canada + 9% CPI Japan+ 8% CPI Germany).	

Table 2: Unit Root Test

Variables	Test Statistic			
	Canada			
	Level	1st Difference	Level	1st Difference
Oil Price	-1.542	-8.220	-1.542	-8.220
REER	-2.228	-9.781	-1.754	-9.659
Inflation	-4.627		-11.145	
Interest Rate	-1.756	-9.834	-2.008	-10.014
IMP	-1.316	-7.208	-1.216	-8.156
PPI	-0.918	-7.604	-0.337	-8.101
Output Gap	-2.104	-6.257	4.372	-6.749
GDP				

Note: Critical values for the test statistics are: –3.5 at 1%, –2.9 at 5%, and –2.6 at 10%

Appendix B:

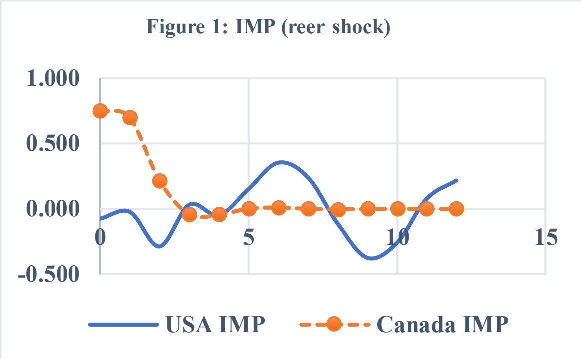
Figure 1: IMP (reer shock)
1.000
0.500
0.000
-0.500
0
5
10
15
USA IMP
Canada IMP

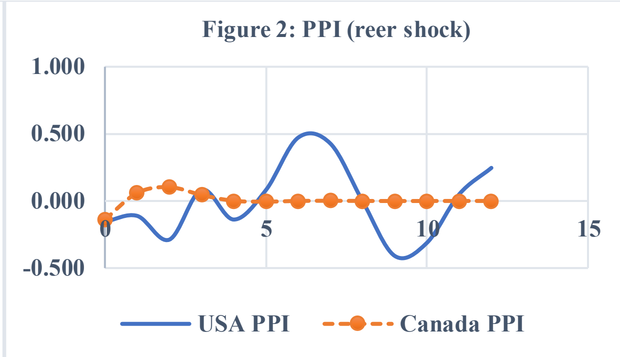
Figure 2: PPI (reer shock)
1.000
0.500
0.000
-0.500
0
5
10
15
USA PPI
Canada PPI

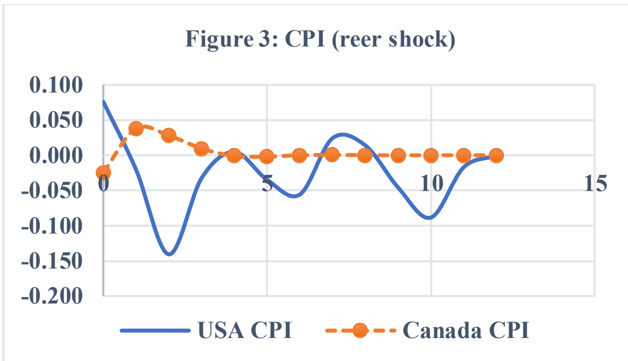
Figure 3: CPI (reer shock)
0.100
0.050
0.000
-0.050
-0.100
-0.150
-0.200
0
5
10
15
USA CPI
Canada CPI