Empirical analysis of Marshall-Lerner Condition between the United States and Canada

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***Abstract*—This paper explores the trade dynamics between the United States and Canada through the lens of the Marshall-Lerner Condition. The Marshall-Lerner Condition asserts that for a currency depreciation to improve a country's trade balance, the combined price elasticities of imports and exports must exceed one. This study evaluates the condition using Error Correction Models (ECMs) to distinguish between short-term and long-term effects on trade balances. The empirical findings reveal that while short-term real exchange rate depreciation has a marginally positive effect on the trade balance, the long-term impact is statistically insignificant. Furthermore, the analysis does not conform to the expected J-curve effect. The study contributes to the understanding of bilateral trade balance adjustments in response to currency fluctuations and offers insights for policymakers and economists.**

***Index Terms*—Marshall-Lerner Condition, Trade Balance, Error Correction Model, Real Exchange Rate, United States, Canada, J-curve.**

I. Introduction

The economic relationship between nations is often mirrored through their trade balances, which signify the difference between the values of a country's exports and imports. In many economic discussions, it's often suggested that balanced trade plays a significant role in maintaining a healthy economy, as it can influence factors like national currency strength and general economic stability. This analysis focuses on the trade dynamics between the United States and Canada, two closely intertwined economies, through the lens of the Marshall-Lerner Condition. Gross Domestic Product (GDP) plays a pivotal role in understanding and predicting changes in the trade balance. The GDP equation,

$$\text{GDP} = C + I + G + (X - M)$$

where C represents consumption, I is investment, G stands for government spending, and XM denotes net exports (exports minus imports), highlights the contribution of trade balance to the nation's economic output. An improvement in net exports can lead to a positive shift in GDP, emphasizing the importance of maintaining a favorable trade balance. Countries often aim to maintain a positive trade balance, as it is often associated with robust economic health, increased job opportunities in export-related sectors, and a surplus that can help cushion against economic downturns. Moreover, the trade balance plays a role in determining a country's currency value. A positive trade balance can potentially strengthen the country's currency since foreign buyers must acquire the domestic currency to pay for exports. Additionally, the trade balance carries strategic significance. A notable trade deficit might suggest some reliance on foreign goods and services, potentially posing certain risks to national security and sovereignty, although complete independence might not be a desirable outcome. However, achieving and maintaining this balance is complex and influenced by various factors including exchange rates, economic policies, and global economic conditions. In the context of the United States and Canada, the trade balance is not just a measure of economic success but a reflection of deeply integrated supply chains and shared economic interests. This paper explores how fluctuations in real exchange rates between the two countries, examined through the Marshall-Lerner Condition, impact their trade balance. It will assess whether a real depreciation in the currency of one country leads to a significant improvement in its trade balance with the other, based on the elasticity of demand for exports and imports. Understanding these dynamics is crucial for policymakers and economists alike, as it guides strategic economic decisions and fosters a stable economic environment conducive to growth and prosperity. This introductory exploration sets the stage for a deeper empirical analysis within the subsequent sections of the paper.

II. Theory

2. Theory 2.1. Marshall-Lerner Condition Named after economists Alfred Marshall and Abba P. Lerner, The Marshall-Lerner Condition is a fundamental principle in international economics, particularly in the context of exchange rates and their effects on a country's trade balance. The condition highlights the interplay between currency valuation and trade flows, illustrating how exchange rate movements can influence a country's trade surplus or deficit. It underscores the idea that for a currency devaluation to effectively reduce a trade deficit, the demand for exports and imports must be sufficiently responsive to changes in price. Elaborating more, if a country's exports become cheaper due to real currency depreciation, and if the world demand for these exports is elastic, the volume of exports will increase significantly, potentially improving the trade balance. Similarly, if imports become more expensive and the domestic demand for these

imports is elastic, import volume will decrease, further aiding the improvement of the trade balance. The condition concludes that the sum of the absolute values of the price elasticities (i.e., the responsiveness of demand to price changes) of imports and exports must be greater than one for depreciation (or devaluation) of the currency to improve a country's trade balance. The Marshall-Lerner Condition serves as a critical analytical tool for policymakers and economists, guiding them in making informed decisions regarding currency policies and their broader economic implications, providing the incentive behind this research. Moving to Its derivation, let's consider country A and B, and write the net exports equation for country A. Let X and M be A's export to and import from country B, respectively. The net export for A to B is defined as

$$NX \ = \ X - eM$$

Where, X is the real exports in domestic currency, M is the quantity of imports, e is the real exchange rate of country A's currency, defined as the amount of A's currency required to purchase one unit of B's currency multiplied by the relative price levels of country B and A. Differentiating the equation with respect to e yields,

$$\frac{\partial NX}{\partial e} = \frac{\partial X}{\partial e} - e\frac{\partial M}{\partial e} - M$$

Multiplying both sides of the above equation by (e$_{\overline{X)yields,}}$

$$\frac{e}{X}\frac{\partial NX}{\partial e} = \frac{e}{X}\frac{\partial X}{\partial e} - \frac{e^2}{X}\frac{\partial M}{\partial e} - \frac{e}{X}M$$

When trade between A and B is balanced, X = eM. Applying this condition to the above equation yields,

$$\frac{e}{X}\frac{\partial NX}{\partial e} = \frac{e}{X}\frac{\partial X}{\partial e} - \frac{e}{M}\frac{\partial M}{\partial e} - 1$$

For a depreciation of A's currency to increase A's net export, the left-hand side term of the above equation must be positive, which implies the right-hand side term must also be positive, that is,

$$\frac{e}{X}\frac{\partial X}{\partial e} - \frac{e}{M}\frac{\partial M}{\partial e} - 1 > 0$$

The first two terms on the left-hand side of the above inequality are exchange rate elasticity of A's export and import and denoted by $\eta_{X_E} and \eta_{M_E} respectively. That is,$

$$\eta_{X_E} - \eta_{M_E} > 1$$

Note that theoretically, the elasticity of the import should be negative, meaning as the exchange rate depreciates, the imported goods become more expensive, reducing the demand for imports. Consequently, the equation above can be written as the sum of absolute values of the elasticities to be greater than one.

2.1. J-Curve As discussed, a real depreciation in the exchange rate theoretically will result in higher exports and lower imports. Initially, however, the immediate effect on the trade balance might not be what one would intuitively expect. To elaborate more, since demand and supply are relatively inelastic in the short term, the quantity of imports and exports does not change significantly. Hence, the real depreciation will result in increase and decrease in the volumes of imports and exports, respectively, resulting in a decrease in the balance of trade between the two countries. However, in the long-run, as the demand for goods get adjusted to the new prices, one would expect an improvement in the trade balance. Such phenomenon is called the J-curve, demonstrated in the graph *, showing the negative effect of the real depreciation at the start, and the positive effect in a longer timeframe, although the positive effect doesn't necessarily mean a surplus in the balance of trade.

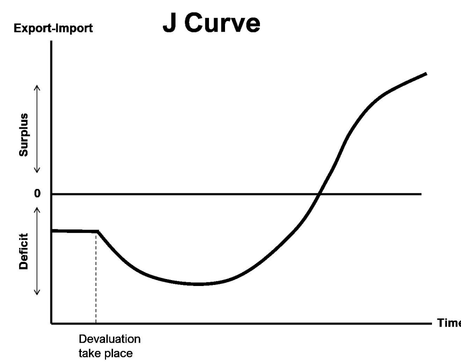

Fig. 1: The demonstration of the J-curve

III. Literature Review

There are several studies on the Marshall-Lerner condition, specifically focusing on the US.

[1], Adhikari (2018), motivated by the problematic trade deficit of the US had been experiencing with China examined the ML condition and J-curve between 1992 and 2016. The core equation for the long-run trade balance (XTM) used in the analysis is written as:

$$XTM = \beta_0 + \beta_1 \text{USGDP}_t + \beta_2 \text{CRGDP}_t + \beta_3 \text{REX}_t + u_t$$

Where XTM is the logarithm of the ratio of US export to China to US import from China. USGDP and CRGDP are logarithm of real GDP of the US and China respectively. REX is the real exchange rate between the two countries and u is an error term.

In the above model, the absolute value of the sum of the elasticities of export and import with respect to the exchange rate (the coefficient of the exchange rate) must be greater than one for the condition to hold. They utilized the VECM framework to study the long-term and short-term effects of the variables, including 2 lags of each in the final specification. The study concluded that while the US dollar's depreciation has a significant and negative impact on the US-China trade balance in the short run, supporting the J-curve effect, this effect was negative and insignificant in the long-run suggesting the Marshal-Lerner condition does not hold in the case of US and China.

[2] investigates this condition for the bilateral trade balances between the U.S. and each of the other G7 member countries from 1985 to 2016. The specified model was very similar to Adhikari's; However, they introduced dummy variables for the exchange rate term, differentiating between different threshold levels of the exchange rate levels. The key findings of Dong's research indicate that price elasticities of exports and imports do not fulfill the Marshall-Lerner condition across the two regimes established by real exchange rate depreciation levels (high-depreciation regimes and low-depreciation regimes, as in, dataset is divided using certain levels of real exchange rate. The thresholds are detected using Hansen's Threshold Model Test), for three countries. Consequently, this suggests that a higher real exchange rate depreciation does not necessarily result in an improved bilateral trade balance between the U.S. and the three of the other G7 countries in either of the regimes.

In the study by [3], the authors explored the Marshall-Lerner condition at the commodity level, specifically in the context of Korea-U.S. trade. In contrast to the previous studies the researchers utilized quarterly data over the period from 1991Q1 to 2012Q4 and examined the Marshall-Lerner condition on 10 industries separately. The results of their empirical analysis revealed that the Marshall-Lerner condition is satisfied in four out of the 10 industries studied. These four industries accounted for almost 65[4], took two approaches for examining the ML condition for 5 countries including the US, using monthly data from 1974 to 1986. First, she an approach, similar to Adhikari's stated above with a suitable number of lags, as she pointed out that structural estimation of the demand functions of export and import, and deriving the trade balance equation is a rather difficult task; as even the simple specification the common demand functions for both might be biased. Results for this approach were, the sum of the effects of differences for the exchange rate were negative on the trade balance for 3 out of 5 countries (the US being one of the two, experiencing a positive impact). After the analysis, she utilized locally weighted regression as a non-parametric to test the condition. Here, she first regressed omitting the exchange rate as an explanatory variable,

$$y_t = f\left(x^*{}_t\right) + \varepsilon \ , t = 1 \ldots T$$

Where f(x) calculates a variable number of closest points to x. the metric used is $|| \cdot ||_2$, and the number of points used is determined by

$$W = T\left[\frac{|x^* - x|_2}{|x^* - x|_2}\right],$$

where T is the Tricube function defined as:

$$T(v) = \begin{cases} (1 - v^3)^3, & \text{if } v < 10, \\ \text{else}, & \text{otherwise.} \end{cases}$$

Thereafter, the real exchange rate was added and R-squared was re-estimated. The hypotheses, due to difficulty of doing F-test, was tested using the bootstrapped critical values for the distribution of the percentage reduction in the sum of squared residuals. The results followed the previous approach, that is, exchange rate wasn't a determining factor in the trade balance.

In the review paper by [5], the empirical evidence of the J-curve was studied. They pointed to the fact that the net change in the trade balance depends on the currency in which contracts are denominated and hence, the relative bargaining power of the countries involved. The reviewed studies in the paper were divided into two, aggregated trade and bilateral trade analyses. Regarding the aggregate trade studies, [6] suggested that the progression of the trade balance might follow a W-shaped curve instead, since in the immediate time, the trade balance worsens as the j-curve suggests, thereafter with the new contracts put into place and due to supply lags, there'll be slight improvements. This would follow by a decrease in the trade balance again since change in the buying habits from the demand side will take more time. Finally, the depreciation would result in improvements, thus a W-curve.

[7] looked for the evidence of the J-curve by considering three subcategories: non-oil industrial supplies, capital goods excluding automobiles, and consumer goods. Her findings suggest the decreasing portion of the J-curve is rather short-lived for industrial supplies and materials. Capital goods do not experience a decrease in trade volume. Interestingly, consumer goods seem unaffected by the change in exchange rates.

IV. Model

4.1 Error Correction Models Error Correction Models (ECMs) are statistical models used primarily in the study of time series data to estimate the speed at which a dependent variable returns to equilibrium after a change in other variables. They are particularly useful in scenarios where the relationship between variables is believed to be long-term or equilibrium-based, but may deviate from this equilibrium in the short term due to various shocks or adjustments. ECMs distinguish between short-term fluctuations and long-term relationships by integrating both levels and differences of the variables into a single framework, allowing for more nuanced analysis than traditional models that focus solely on one or the other. The key feature of an ECM is the error correction term, which quantifies the deviation from the long-term equilibrium. The general form of an ECM can be represented as follows:

$$\Delta y_t = \alpha + \beta \Delta x_t + \gamma \left(y_{t-1} - \theta x_{t-1}\right) + \varepsilon_t$$

Here, Δy_t and Δx_t represent the changes in the dependent variable y and the independent variable (x) from one period to the next, respectively. The term $y_{t-1} - \theta x_{t-1}$ measures the deviation from the equilibrium relationship in the previous period, with θ representing the long-term equilibrium coefficients. The coefficient γ captures the speed of adjustment back towards equilibrium, and ε_t is the error term. This framework allows the model to capture both the short-term dynamics (through the changes in variables) and the long-term equilibrium relationship (through the error correction term), providing a comprehensive understanding of the variables' interactions over time.

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4.2 Model Specification The following equations demonstrate the demand functions for export and import. Export of the US is a function of the Canada's GDP (perceived as income or wealth), and the real exchange rate (perceived as the price). Similarly, import is dependent on the US's GDP and real exchange rates. Approximating with the log of the variables with result in the coefficients to be elasticities.

$$X^{US} \ = \ \beta_0 \ + \ \beta_1 CANGDP \ + \ \beta_2 RE \ + \ e$$

$$M^{US} \ = \ \alpha_0 \ + \ \alpha_1 USGDP \ + \ \alpha_2 RE \ + \ v$$

Where CANGDP and USGDP are the real Gross Domestic Products of Canada and the US, and X^{US} and M^{US} are the real US's exports to and imports from Canada, respectively. Additionally, v and e are random errors of the regressions. By subtracting both of the equations in the log form, the coefficient of the logarithm of the real exchange rate will be the ratio of the elasticities, allowing for the ability to test the Marshal-Lerner condition directly,

$$log\left(X^{US}/M^{US}\right) = \gamma_0 + \gamma_1 log\left(USGDP\right) + \gamma_2 log\left(CANGDP\right) + \gamma_3 logleft(RE \ + \ \omega$$

Where γ_3 will be the sum of the elasticities and ω is the random error of the regression. The real exchange rate used above is calculated using the CPI of both countries and the nominal exchange rate ,

$$RE = \frac{\mathrm{CPI}_{\mathrm{Canada}} \times e_{(USD/CAD)}}{\mathrm{CPI}_{\mathrm{USA}}}$$

However, in the ECM framework, the derived equation can be expected as the long-run estimation of the relationship. As discussed, utilizing the Error correction framework will allow the model to account both for the short-term, and long-term relations of the equation. Consequently, in here, u_t will be partially corrected in the next period.

$$\Delta NX = \theta_0 \left(NX_{t-1} - \gamma_0 - \gamma_1 USGDP_{t-1} - \gamma_2 CANGDP_{t-1} - \gamma_3 RE_{t-1} + \theta_1 \Delta USGDP_t + \theta_2 \Delta CANGDP_t + \theta_3 \Delta RE_t + \varepsilon_t\right.$$

Where NX is $log\left(X^{US}/M^{US}\right)$ and the term in the parenthesis is the previous deviation from the long-run relationship or the error of equilibrium.
The short-term variables can include lags, number of which can be determined using metrics such as AIC.
Note that in the above model, by replacing the term in the parenthesis with u_{t-1}, the model becomes linear in coefficients, allowing us to use OLS for estimation of the coefficients. Such models are regarded as the restricted model. Using MLE, the coefficients can be estimated in one stage, which is regarded as the unrestricted model and optimized using iterative algorithms such as gradient descent (utilizing first order derivatives), Gauss-newton (utilizing first and second order derivatives), etc.

V. Data

In this part, we're going to look at the annual data we collected for the United States and Canada from 2003 to 2022. We gathered information on real GDP, the deflator, Consumer Price Index (CPI), the exchange rate between the US and Canada, and the nominal values of goods traded between the two countries. This data covers each year from 2003 to 2022. We mainly got our data from FRED, except for the trade figures between the US and Canada.

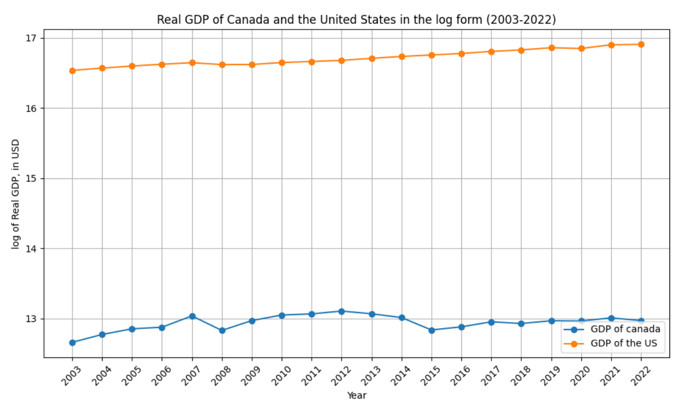

Fig. 2: Real GDP of the US and Canada, in the log form, USD

The GDP of both nations, in their domestic currency demonstrate a pattern of consistent growth, uninterrupted by significant fluctuations except for the financial crisis in 2008, and the global pandemic around the world during Covid. Note that since the GDP of Canada is graphed in USD, the fluctuations above are explained mostly by the fluctuations in the nominal exchange rates.

Price levels, as indicated by deflators, have risen in both countries. The price levels appear to be highly correlated.

Analyzing the nominal and real exchange rates between the Canadian dollar (CAD) and the U.S. dollar (USD), we observe notable fluctuations. The trends in exchange rates can have a substantial impact on the trade balance, as they influence the relative cost of exports and imports. The real exchange rates can be calculated by the CPI and the deflator. However, after examinations, the one calculated by the CPI resulted in better

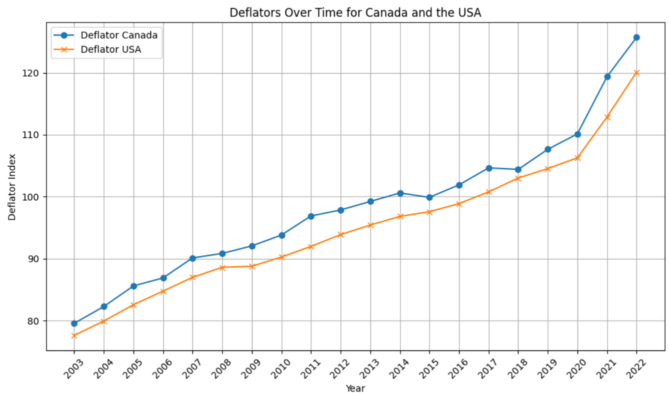

Fig. 3: The change in price levels in the US and Canada

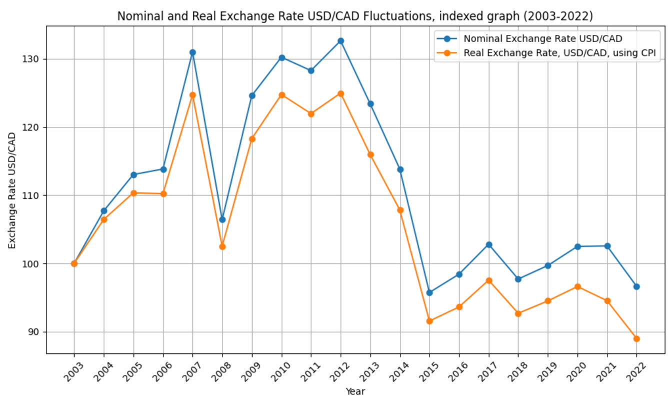

Fig. 4: changes in nominal and real exchange rates calculated using the CPI indexes

analysis. Additionally, although the exchange rate in the period considered in this study seems to experience a downward trend from 2007 and on, it looks rather stationary during longer periods.

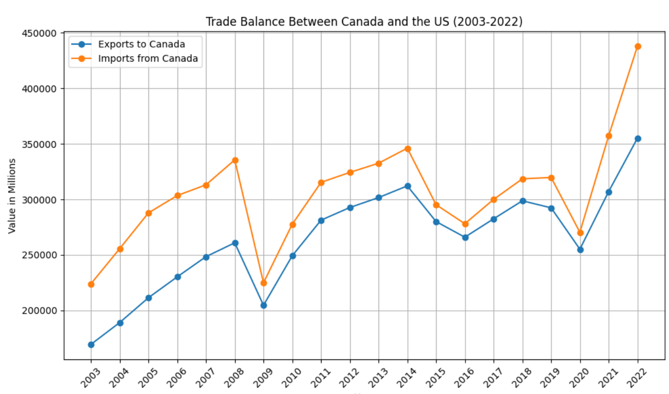

Fig. 5: real import and export between the US and Canada

Trade: in general, both exports and imports have been increasing over time, meaning the economic ties between the 2 countries is strengthening. The trade balance data highlights a persistent trade deficit for the United States with respect to Canada. The U.S. has consistently imported more from Canada than it has exported to its northern neighbor. In 2009 followed by the financial crisis and 2020 when covid happened, both exports and imports decreased, but the decrease in imports was more drastic. It's understandable since on theoretical grounds, imports from Canada is an increasing function of the US's income/GDP.
In addition to these observations, one could explore the correlation between the GDP growth rates and the trade balance to further understand the impact of economic expansion on trade balance. The impact of exchange rate fluctuations on trade volume and the trade balance could also provide additional insights into how sensitive bilateral trade is to currency valuation changes. the correlation and its corresponding t-statistics' were calculated:

	X^{us}, real e	X^{us}, GDP$^{\mathrm{can}}$	M^{us}, real e	M^{us}, GDP$^{\mathrm{us}}$
Correlation	-0.3	0.8*	-0.2	0.6*
t-statistic	1.2*	6.7*	1.0*	3.1*

TABLE I: Correlation and t-statistic values for various variables

Theoretically, the export of the US should be positively correlated with Canada's GDP, Similarly, it's import positively correlated to its own GDP. These relationships have the expected signs and are statistically significant. As for the exchange rates, US exports should increase as real e, as defined above, increases. This relationship does not hold but is statistically insignificant. However, the corresponding figure between imports and the real exchange rate is expected to be negative. In other words, with increase in the exchange rate, the goods of the other country become more expensive, and hence, the demand decreases. However, the relationship appears to be statistically insignificant.

Additionally, the stationarity of the variables in the log form was tested using the augmented dickey fuller. The results are provided in the table below,

Var	Asymptotic p-value
CANGDP	0.09833
USGDP	0.9374
RE	0.6285
X	0.1039
M	0.05524

TABLE II: Stationarity tests for the variables used in the long-run equation

Note that the setting in which the test was conducted was constant with a trend, except for RE, which was tested only with a constant. As the p values suggest, the null hypothesis of non-stationarity can only be rejected for the imports. None of the other variables seem to be stationary. This was expected from all the variables, except the real exchange rate. However, as stated earlier, if longer periods were tested, the results would have been different as the charts suggest. I note that the unit root tests have low power and tend to accept the null of non-stationarity too often.

VI. Result

This section of the research paper discusses the empirical findings from two specified models evaluating the Marshall-Lerner condition between the United States and Canada over different periods.

$$\begin{aligned}\log\left(\frac{X}{M}\right) &= \gamma_0 + \gamma_1 \log\left(USGDP\right) \\ &+ \gamma_2 \log\left(CANGDP\right) \\ &+ \gamma_3 \log\left(RE\right) + \epsilon \,(1)\end{aligned}$$

$$\begin{aligned}\Delta \log\left(\frac{X}{M}\right)_t &= \beta_0 \left(\epsilon_{t-1}\right) \\ &+ \beta_1 \Delta USGDP_{t-1} \\ &+ \beta_2 \Delta CANGDP_{t-1} \\ &+ \beta_3 \Delta RE_t \\ &+ \varepsilon_t \,(2)\end{aligned}$$

Restricted ECM The long-run and short-run regression results are provided in table 3 and 4 respectively, capturing the restricted ECM. Equation 1 represents the long-run equilibrium condition. Equation 2 is the error-correction model.

The long-run relationship has a relatively high R2 (0.55) and the Durbin Watson is significantly greater than the critical value of 0.4, suggesting the existence of cointegration and a strong long-run equilibrium relationship.
The long-run coefficient for RE, representing the long-run elasticity of the real exchange rate, is positive at 0.143328 but not statistically significant (t-test = 0.75). The lack of significance suggests that the long-term depreciation of the real exchange rate does not have a discernible impact on the trade balance. However, in the short-run (Table 4), the coefficient of RE is positive (0.17) and more significant with the t-statistic of 1.457 implying significance at the 17% level and causing a positive change on the balance of trade. This contradicts with the J-curve, which expects a negative effect on the trade balance in the short-run.
Additionally, signs for long-run effect of USGDP and CANGDP are as expected, illustrating the fact that both in short-run and long-run, the trade balance improves with an increase in Canada's GDP and worsens with increase in the US's GDP. The coefficient of adjustment towards the long-run equilibrium is negative and highly significant suggesting the existence of the long-run equilibrium trade relationship

Table 4 shows the results of the Error Correction model. The adjustment coefficient is significant and has the correct sign. It suggests 40% of shocks/deviations from the long-run equilibrium relationship will get corrected every year. The short run effect of a change in Canadian GDP is insignificant but the short-term changes in the US GDP has a negative and significant effect of the net trade between the two countries. Also, short-term changes in the real exchange have a positive and significant effect on the net trade between Canada and the US.

	Coefficient	T-statistic
const	-16.0342	-3.288
CANGDP	2.37319	2.087
USGDP	-1.53838	-1.43
RE	0.143328	0.7509
R^2		0.55
DW		1.28

TABLE III: OLS results for the equation (1)

Column1	Coefficient	T-statistic
const	0.0273917	1.777
$\in_{t-1}$	-0.401683	-1.841
ΔCANGDP$_{t-1}$	0.858896	0.8936
ΔUSGDP$_{t-1}$	-1.66824	-1.715
ΔRE	0.175839	1.457
R^2		0.55
DW		1.71

TABLE IV: OLS results for equation (2)

Note that, we repeated the regression using the real exchange rate calculated by GDP deflator instead, the results persisted and the statistical significance of the variables were lowered. Hence, all the rest of the calculations were done using the real exchange rate calculated by CPI.

Unrestricted ECM
The model 2 above can be written in an unrestricted form as:

$$\begin{aligned}\Delta \log\left(\frac{X}{M}\right)_t &= \beta_0 + \beta_1 \log\left(\frac{X}{M}\right)_{t-1} \\ &+ \beta_2 \cdot USGDP_{t-1} \\ &+ \beta_3 \cdot CANGDP_{t-1} \\ &+ \beta_4 \cdot RE_{t-1} \\ &+ \beta_5 \cdot \Delta USGDP_t \\ &+ \beta_6 \cdot \Delta CANGDP_t \\ &+ \beta_7 \cdot \Delta RE_t \\ &+ \varepsilon_t \;\; (3)\end{aligned}$$

Model 3 can be estimated using OLS. Results are shown in Table 5. Similar to previous specification, this demonstrates a positive short-term effect of RE. However, the long-run effect, indicated by the ratio of coefficients of RE_{t-1} to $X_{t-1}\ M_{t-1}$, is positive (0.329907066), yet both the numerator and denominator show low t-statistics indicating non-significance. This suggests that, in the long run, depreciation does not significantly influence the trade balance.

Finally, similar to the previous result, this model does not follow the J-curve, but an inverse J-curve, as it improves in the short run, but in the long-run, it is resulting in a decrease in trade balance.

TABLE V: Regression coefficients and statistics

Column1	Coefficient	T-statistic
const	-7.20511	-1.752
ΔCANGDP	-0.992939	-1.26
ΔUSGDP	-0.294279	-0.3903
ΔRE	0.190621	2.032
$X_{t-1} - M_{t-1}$	-0.171197	-1.22
CANGDP_{t-1}	1.86882	2.408
USGDP_{t-1}	-1.76997	-2.711
RE_{t-1}	-0.0564791	-0.574
R^2		0.85
DW		2.30

VII. Conclusion

The empirical evidence from Models restricted, and unrestricted error correction models presents a nuanced view of the Marshall-Lerner condition's applicability between the USA and Canada. Short-term real exchange rate depreciation appears to have a positive but not strongly significant effect on the trade balance. However, the long-term impact is consistently insignificant across the models. These results suggest that while currency depreciation might offer some marginal short-term trade balance improvements, its long-run effects are negligible and in general, do not conform to the expected outcomes of the Marshall-Lerner condition. Additionally, the models do not show any evidence for the presence of J-curve for the changes in balance of trade.

Future research could extend these findings by incorporating additional variables that may capture other influences on the trade balance, or by examining different time periods to understand the potential changes in economic relationships over time.

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