U.S.-JAPAN AND U.S.-CANADA BILATERAL REAL TRADE BALANCES: AN EMPIRICAL EXPLORATION

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ABSTRACT

U.S.-Japan as well as U.S.-Canada bilateral real trade balances, real exchange rates and relative real GDP is non-stationary in levels revealing I (1) behavior. There are evidence of co integration, long-run bi-directional causal flows among variables with no clear evidence of feedbacks in different lag structures.

INTRODUCTION

Japan and Canada are the most important trading partners of the United States of America (U.S.). Japan has the second largest economy of the world despite being in chronic recession since 1988.This is next to the U.S. mega economy ($11 trillion). Historically, U.S. has persistent and yawning trade deficit with the rest of the world. A bulk of it is with Japan alone. From time to time, it became an irritant in the U.S.-Japan economic relations. There has been a significant pressure on Japan from the U.S. to reduce its bilateral trade surplus through voluntary export restraint and import expansion policies. But a huge trade deficit still persists and even continues to swell despite gradual opening of the Japanese market to U.S. products. This is attributed to a much faster pace in U.S. economic growth than in Japan.

Canada tops the list of major trading partners of the U.S. This country is overly dependent on the U.S. market for its exports and imports (some 90 percent). It occupies a unique position as a U.S. trading partner because of its geographic proximity with the U.S. and being a member of the North American Free Trade Agreement (NAFTA). In the post-NAFTA period, the U.S.-Canada trade volume continues to rise at a considerable pace. Given the paramount importance of Japan and Canada to U.S. foreign trade, the issue of the dynamics of U.S. real trade balances with these countries merits an in-depth inquiry.

The primary objective of this paper is thus to address the aforementioned issue within the co integration framework. The remainder of the paper is organized as follows. Section II provides a survey of the related literature. Section III outlines the empirical design. Section IV reports the empirical results. Finally, section V concludes.

SURVEY OF RELATED LITERATURE

Among a host of macroeconomic explanators of bilateral exports and imports, relative GDP and exchange rates have gained prominence in the mainstream empirical literature on this subject of paramount importance. Numerous studies focused on the functional forms of imports and exports [Burgess, (1974), Houthakker and Magee (1969), Kreinin (1967), Leamer and Stern (1970), Magee (1975), Ball and Marwah (1962), Khan and Ross (1977), Goldstein and Khan (1985), Boylan et al., (1980), Kohli (1990)]. The major conclusions that emerge from these studies on the functional forms are either linear or log-linear. Subsequently, [Volker (1992), Feenstra (1995), Sawyer (1999), Matscebayashi (1999)] re-examine similar issues and draw similar inferences.

The depreciation of the dollar against foreign currencies confers a price advantage for U.S. exports relative to those of the U.S. trading partner nations. Yet, it is by no means clear that the volume of these exports will increase by more than the decrease in their dollar prices. Unless the export volume increases by more than the export prices fall, the resulting dollar value of the exports will drop. Furthermore, exports to these countries depend not only on export prices, but also on their real economic growth. The U.S. aggregate nominal trade data over the last three decades reveal that nominal exports and nominal imports are more closely correlated with each other than with the movements in the nominal external value of the dollar. The correlation between total nominal exports and total; nominal imports during the 1972 to 2002 period at 0.98 was incredibly high while the correlation between nominal exports and nominal imports as a percentage of nominal GDP was 0.77. As a result, the nominal depreciation of the U.S. dollar since 1972 has been closely correlated with expansion in U.S. total nominal exports and equally correlated with the growth in U.S. total nominal imports leading to no reductions in the U.S. trade deficit (Blaine, 1996). Furthermore, Husted (1992) maintains a similar view that no matter how U.S. total exports and total imports are measured, they are always highly correlated with each other. But this may not be necessarily true for the bilateral real trade among the U.S., Canada, and Japan. Rahman, Mustafa and Burckel, (1997) find no long-run association but find some short-run relationship between the yen-dollar real exchange rate changes and the U.S.-Japan real trade balance. Rahman and Mustafa (1999), using annual data from 1970 through 1995 and the ADF test of co integration, find no co integrating (long-term equilibrium) relationship between these variables. However, they find some short-run bidirectional Granger causality. Despite a wide publicity and profound ramifications for U.S. open-door trade policy towards Canada, and Japan, a few studies have addressed the issues of real export, real import and real exchange rate linkages in depth while numerous casual observations and detailed descriptive accounts using nominal data are readily available. Formal modeling and data analyses at the theoretical and empirical levels are limited in number. More recently, Bahmani-Oskooee and Ratha (2004) considering 18 major trading partners of the U.S. is unable to discover any J-curve pattern in the short run. But favorable effects of real depreciation of the dollar on the U.S. trade balance are confirmed in most cases.

There is also an evolving literature about estimates of U.S. and/or Japan exports and import functions using a co integration approach [Caporale and Chui (1999), Carone (1996), Clarida (1994), Geglowski (1997), Hamori and Matsubayashi (2001), Hooper and Marquez (1995), Marquez (1999), Parsons (2002)]. To state briefly about the latest ones, Hamori and Matsubayashi (2001) empirically analyze the stability of the Japanese import demand function using the concept of co integration. The results do not support the presence of a stable co integrating relation among real GDP, real imports and relative import prices. Parsons (2002), tests for co integration of Japanese real imports of semiconductors, real gross domestic expenditure (GDP) and relative prices. This paper concludes that rapid growth of imports during the 1980s and 1990s was attributed to growth in real GDE and change in relative prices independent of the Voluntary Import Expansion (VIE) policy. Marquez (1999) investigates long-period trade elasticity's for Canada, Japan and the U.S. The elasticities are found to be inconsistent with the view that income and prices affect imports.

EMPIRICAL DESIGN

The causal relationship between real exchange rate and real trade balance may be explained in terms of "income" and "substitution" effects. Theoretically, there are two possible connections between the balance of trade and the exchange rate. One is the "income effect" in which the dominant influence runs from the trade balance to the exchange rate. The other is the "substitution effect" in which the effect stems from exchange rate to the balance of trade. With the income effect, an exchange rate appreciation in real term will lead to substitution of exports for imports and hence a deterioration in the balance of trade. However, the income effect generally dominates the substitution effect through the business cycle because it takes longer for prices than income to effect trade flows.

To provide theoretical motivation for this empirical work, the following export and import functions are specified:

$$V_x = f(e, y^*) \ldots\ldots\ldots\ldots\ldots(1)$$

$$V_m = f(e, y) \ldots\ldots\ldots\ldots\ldots(2)$$

Where, V_x = real value of exports in local currency, e = bilateral real exchange rate (units of home currency per U.S. $), y* = foreign real GDP, V_m = real value of imports in local currency, and y = real domestic GDP.

Both e and y* exert positive influences on V_x. As home currency depreciates against U.S. $ in real term, the exports become cheaper in foreign markets resulting in higher exports. At the same time, a surge in foreign real GDP boosts foreign demand for goods causing exports to rise. Conversely, depreciating local currency against U.S. dollar in real term makes foreign goods more expensive in local markets. As a result, imports decline. Also, an increase in domestic real GDP spurs domestic demand for goods resulting in higher imports.

From equations (1) and (2), the real trade balance (TB) is formulated in ratio form for scaling purposes (Bahmani-Oskooee and Brooks, 1999) as follows:

$$\frac{Vx}{Vm} = \text{F (e, } \frac{y*}{y}\text{)}$$

$$\text{Or TB} = \text{f (e, } \frac{y*}{y}\text{)} \quad (3)$$

A univariate analysis is conducted to investigate the stationary properties for each time series by implementing the most commonly used ADF test (Dickey and Fuller, 1981), and its opposite counterpart, the KPSS test (Kwiatkowski, et al., 1992). To clarify further, the ADF test is about data non-stationary assuming a unit root in each time series while the KPSS test is about data stationary assuming no-unit root in each time series. A time series variable to be non-stationary, I) its variance is time-variant and it goes to infinity as time approaches infinity, ii) it depicts no long run mean-reversion, and iii) theoretical autocorrelations do not decay but the sample correlogram dies out slowly in finite samples. To be co-integrated, all variables must have the same order of integration (Engle and Granger, 1987). They reveal I (1) behavior, if stationarity is induced on the first differencing of the level data.

Next, the co-integrating relationships (the tendency for variables to move together in the long run) between or among the variables are determined by using the VAR approach as developed in Johansen (1988, 1991), and Johansen and Juselius (1990, 1992). The appropriate lag-length (P) is selected with the aid of the FPE criterion (Akaike, 1969) to reduce the problem of autocorrelation in residuals or to ensure that the errors are white noise. This helps outcome the problem of over/under parameterization that may induce bias and inefficiency in the estimates. The analysis commences with a congruent statistical system of unrestricted reduced forms as follows:

$$Y_t = \mu + \sum_{i=1}^{P} \pi Y_{t-i} + \xi_t; \; \xi_t \sim IN(0, \Omega), \quad i = 1, 2, \text{T} \quad (4)$$

Where Y_t is an (nx1) vector of I (1) and /or I (0) variables, and μ is an (nx1) vector of constants.

Letting $\Delta Y_t = Y_t - Y_{t-1}$, a convenient reparameterization of equation (4) is given by:

$$\Delta Y_t = \mu + \sum_{i=1}^{P-1} \Pi \Delta Y_{t-i} + \Pi Y_{t-P} + \xi_t \quad (5)$$

Since ξ_t is stationary, the rank, r, of the long run matrix π determines how many linear combinations of Y_t are stationary. If r=n, all Y_t are stationary, while if r=0 so that π=0, ΔY_t is stationary as are all linear combinations if Y_t~I (1). For 0<r<n, there exist r co integration vectors meaning r stationary linear combinations of Y_t. If this is the case, $\pi = \alpha\beta'$, where both α and β are

nxr matrices. The cointegrating vectors of β are the error-correction mechanisms in the system, while α contains the adjustment parameters.
The cointegrating rank, r, can be formally tested with maximum eigen value test ($\lambda_{\max}$) and the trace test (λ_{trace}).
They are computed as follows:

$\lambda_{\max} = -T\ln(1-\hat{\lambda}_{r+1})$ Where the appropriate null is r=g cointegrating vectors with (g=0, 1, 2, 3,) against the alternative that r$\leq$g+1.

$\lambda_{trace} = -T\sum_{i=r+1}^{n} \ln(1-\hat{\lambda}_i)$ Where the null is r=g against the more general alternative r$\leq$n.

If cointegration is detected, the relevant error-correction term (EC) obtained from the cointegration regression must be included in the standard causality test to avoid the problem of misspecification. The Usual t-test is applied to the co-efficient of the one-period-lagged error-correction term (EC_{t-1}). The t-statistics indicates the existence of long-run causality, while the significance of joint F-statistic indicates the presence of short-run causality. The estimating error-correction model is specified as follows:

$$\Delta Xt = \mu_t + \sum_{i=1}^{n}\beta_i \Delta X_{t-i} + \sum_{i=1}^{K}\psi_i \Delta Y_{t-i} + \sum_{i=1}^{m}\Theta i \Delta Z_{t-i} + \gamma EC_{t-1} + \upsilon_t \quad (6)$$

Where X = U.S. real trade balance with Japan or Canada, y = Real bilateral exchange rate in terms of U.S. dollar, Z = Real relative GDP, Δ = first difference operator, EC = error-correction term, υ =random disturbance term, and t = time subscript.

Usually, trade balance is computed by subtracting a country's total import payment from its total export receipts during a given period. In this study, trade balance is considered as a ratio of total export receipts to total imports. For balanced trade, total export receipts equal total import payments, i.e., the ratio is equal to 1. The ratio being less than 1 indicates unfavorable trade balance and it being more than 1 is a revelation of favorable trade balance. For logarithmic transformation of the variables, trade balance is expressed in ratio form. The log-linear specification is considered to capture the interactive relations among variables, to mitigate the contaminating effects of outliers in data, and to induce some variance homogeneity.
Quarterly data are employed in this study from 1973: I through 2002: IV. The sample period begins from 1973 to correspond to the flexible exchange rate system that provides an excellent opportunity to observe and analyze movements in and interactions between exchange rates and external adjustments. The data in real term are collected from various issues of the International Financial Statistics, published by the International Monetary Fund (IMF) except the bilateral nominal exchange rates that have been collected from the various issues of the Federal Reverse Bulletin. They have been converted into their real counterpart by adjusting with the relative overall consumer price indices. The

overall consumer price indices have been used despite their upward bias to the extent of 1.1 percent in U.S. CPI (Popkin, 1997) as stated also in the Boskin Commission Report. These data are readily available. All the variables used in ratio forms are in real term instead of nominal term since movements in real variables reflect the real transformations of the economies through global reallocations of real resources. To add further, the 30-year sample period may not be adequate for a very meaningful cointegration analysis. The Use of a relatively high frequency quarterly data is intended to partially compensate for the relatively inadequate sample period (Zhou, 2001). The cointegration and error-correction modeling is Used because it poses valuable insights into the dynamics of bilateral trade.

RESULTS

To examine the time series property of each variable, both ADF and KPSS tests are implemented. Subsequently, the order of integration of each variable is determined. This section is organized in two subsections. The first subsection begins with the issue of U.S.-Japan real trade balance. The results are reported as follows:

TABLE 1
(U.S.-JAPAN) *UNIT ROOT TESTS

Variable	ADF Test	KPSS Test
X	**-3.0373 (4)**	**0.2803 (4)**
Y	**-1.1189 (4)**	**0.3519 (4)**
Z	**-2.7366 (4)**	**0.3689 (4)**
First Difference		
ΔX	**-3.8448 (4)**	**0.06144 (4)**
ΔY	**-5.9919 (4)**	**0.0355 (4)**
ΔZ	**5.5778 (4)**	**0.02864 (4)**

*ADF regression includes a constant term and time trend.

The optimum lag-lengths are provided in parentheses. For ADF statistics at 5 percent and 10 percent levels of significance, the critical values are -3.50 and -3.18, respectively [see Fuller (1996)]. For KPSS test, lag window size, 1 = 4, and at 5 percent and 10 percent levels of significance, the critical values are 0.146 and 0.119, respectively.

Where, X = Log of U.S. real trade balance with Japan (U.S. real exports to Japan/U.S. real imports from Japan, Y = Log of Yen-dollar real exchange rate, and Z = Log of real U.S. GDP/log of real Japanese GDP

Both ADF and KPSS tests reveal nonstationarity of each variable at 5 and 10 percent levels of significance as their actual values are compared with their respective and corresponding critical values. The lower segment of Table 1 also confirms that each variable has the first-order of integration indicating I (1) behavior.

In light of the above, the Johansen-Juselius procedure is executed to search for a cointegrating relationship among the variables. The results are reported as follows:

TABLE 2
(U.S.-JAPAN)
JOHANSEN-JUSELIUS COINTEGRATION TESTS

DATA VECTOR	HO:	HA:	Λ_{MAX}	Λ_{TRACE}
	r ≤ 0	r = 1	12.195*	23.120*
(X, Y, Z)	r ≤ 1	r = 2	8.996	10.929
	r ≤ 2	r =3	1.9321	1.9321

*Significant at the 10 percent level.

The λmax and λtrace tests confirm the existence of at least one cointegrating vector in the system implying a long run equilibrium relationship among U.S.-Japan real trade balance, yen-dollar real exchange rate, and relative real GDP at 90 percent level of confidence.

As there is an evidence of cointegration among the variables, the vector error-correction model (VECM) with its reverse specification is implemented as a system to detect the long-run causal flows among variables and their short-run feedbacks or interactive relationships. The results are reported as follows:

Table 3 discloses long-run bidirectional causal flows between yen-dollar real exchange rate and U.S.-Japan real trade balance as reflected through the coefficients of the error-correction terms and the associated respective t-values at 90 percent level of confidence. There is no clear evidence of short-run interactive reinforcements between the variables based upon the numerical values of the joint F-statistic. Likewise, similar inferences are drawn between U.S.-Japan real trade balance and relative real GDP.

TABLE 3
(U.S.-JAPAN)
ERROR-CORRECTION/CAUSALITY TEST

Dependent Variable	Causal Variable	Lag-Orders	F-Statistic	Error-Correction Term (t-statistic)
ΔX	ΔY	4	0.7173	-0.0924 (-1.99811)*
ΔX	ΔZ	4	0.4837	-0.0924* (-1.99811)
ΔY	ΔX	4	1.5477	-0.73764 (-1.35507)
ΔZ	ΔX	4	1.5871	-0.0183 (-1.48927)

*Significant at the10 percent level.

The second subsection of the paper explores empirically the same issues for U.S. and Canada. The ADF and KPSS test results including the order of integration of each variable are reported as follows:

TABLE 4
(U.S.-CANADA)
UNIT ROOT TESTS*

	ADF	KPSS
X	-2.5638 (4)	0.16507 (3)
Y	-3.09085 (4)	0.24631 (1)
Z	-3.226 (4)	0.26278 (2)
	First Difference	
ΔX	-5.0293 (4)	0.05651 (4)
ΔY	-4.96437 (4)	0.02911 (4)
ΔZ	-5.4962 (4)	0.02844 (4)

*See footnote from Table 1 for the critical values

Where X = Log of U.S. real trade balance with Canada (U.S. real exports to Canada/U.S. real imports from Canada, Y = Log of the Canadian dollar-U.S. dollar real exchange rate, and Z = Log of U.S. real GDP/log of Canadian GDP.

Table 4 shows that each variable is non-stationary at 5 and 10 percent levels of significance, based upon both ADF and KPSS test results by comparisons of their actual values with the relevant critical values. This is also further obvious from the lower segment of the table that each variable has the first-order of integration and reveals I(1) behavior.

The next step is to investigate the issue of cointegration in this trivariate system by implementing the Johansen-Juselius procedure. The results are reported as follows:

TABLE 5
(U.S.-CANADA)

Johansen-Juselius Cointegration Tests

Data Vector	H_o:	H_a:	λ_{max}	λ_{trace}
	$r \leq 0$	$r = 1$	27.37*	37.5078*
(X, Y, Z)	$r \leq 1$	$r = 2$	6.679	10.1355
	$r \leq 2$	$r = 3$	3.455	3.455

***Significant at the 1 % level.**

It is obvious. That both λ_{max} and λ_{trace} test results, as shown above, affirm the presence of at least one cointegrating vector among the variables at 1 percent and higher levels of significance.

In view of cointegrating relationship among the variables, the vector error-correction model (VECM) with its reverse specification is estimated as a system. The results are reported as follows:

TABLE 6
(U.S.-CANADA)
ERROR-CORRECTION/CAUSALITY TEST

Dependent Variables	Causal Variables	Lag Orders	F-Statistic	Error-Correction Term
ΔX	ΔY	2	0.4640	-0.1205 (-1.807)**
ΔX	ΔZ	2	0.7484	-0.117 (-1.8048)**
ΔY	ΔX	2	1.9745	0.68112 (0.59211)
ΔZ	ΔX	2	0.4404	-0.265 (-2.8481)*

***Significant at the 1% level**
****Significant at the 5% level**

The coefficients of the error-correction terms and the associated t-values reveal long-run bidirectional causal flows between U.S.-Canada real trade balance and the Canadian dollar-U.S. dollar real exchange rate as well as between U.S.-Canada real trade balance and relative real GDP with no discernible evidence of interactive feedbacks based upon the numerical values of joint F-statistic.

CONCLUSIONS

Real trade balance, real exchange rate and relative real GDP in each case reveal nonstationarity in levels and I (1) behavior. There is evidence of cointegration among the variables in both cases. The error-correction model with its reverse specification confirms bidirectional causal flows between variables with no clear evidence of interactive feedbacks. The strength and weakness of such relationships are just a matter of degree with varying lag orders. The lag order for U.S. and Japan is 4 quarters while that for U.S. and Canada is only 2 quarters. Table 3 reveals that exchange rate management seems more appropriate to improve trade balance in the long run, while trade balance management appears more sensible in the short run in the case of the U.S. and Japan. Table 6 also suggests similar long run and short-run policies in the case of the U.S. and Canada. This scenario is explainable in terms of the relative dominance of the income effect over the substitution effect, as stated earlier.

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