Agribusiness & Applied Economics Report No. 585 August 2006

The Role of the U.S. Dollar in International Trade

Jungho Baek
Kranti Mulik
Won W. Koo

Center for Agricultural Policy and Trade Studies
Department of Agribusiness and Applied Economics
North Dakota State University
Fargo, North Dakota

ACKNOWLEDGMENTS

The authors extend appreciation to Mr. Richard Taylor and Mr. Jeremy Mattson for their constructive comments and suggestions. Special thanks go to Ms. Beth Ambrosio, who helped to prepare the manuscript.

The research was conducted under the U.S. agricultural policy and trade research program funded by the U.S. Department of Homeland Security/U.S. Customs and Border Protection Service (Grant No. TC-03-003G, ND1301).

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Abstract

This study examines the J-curve phenomenon for the U.S. agricultural trade and compares the effect on agricultural trade relative to U.S. non-agricultural trade. For this purpose, the autoregressive distributed lag (ARDL) model is adopted to estimate bilateral trade data between the United States and her three major trading partners ─ Japan, Canada, and Mexico. We find little evidence of the J-curve for U.S. agricultural trade with Japan, Canada, and Mexico. For non-agricultural trade, on the other hand, the behavior of U.S. trade with industrialized economies such as Japan and Canada follows the J-curve, but not with developing economies such as Mexico.

Keywords: agricultural trade, autoregressive distributed lag model, J-curve effect, non-agricultural trade

Highlights

The J-curve theory is the traditional wisdom of international economics to analyze the relationship between changes in exchange rate and changes in trade balance. It is suggested that the short- and long-run effects of exchange rate fluctuations on the trade balance are different over time. In other words, after a real depreciation, the trade balance deteriorates in the short-run and improves in the long-run, which causes the time path of the trade balance depicted by a tilted J shape. Given the decrease in the value of the U.S. dollar and the simultaneous deterioration of the U.S. agricultural trade surplus during the period of 2002-2004, it is timely and important to explore the effect of exchange rate changes on the trade balance.

The objective of this study is to examine whether there is a J-curve effect for U.S. agricultural trade and to compare the effect on agricultural trade relative to U.S. non-agricultural trade. To that end, the autoregressive distributed lag (ARDL) model is used to estimate quarterly bilateral trade data involving trade flows between the United States and her three major trading partners ─ Canada, Mexico, and Japan ─ for the period of 1989-2004. These three countries account for approximately 40% of U.S. trade in both agricultural and non-agricultural goods.

The results indicate that there is no J-curve effect for U.S. agricultural trade with Japan, Canada, and Mexico. For non-agricultural trade, on the other hand, the behavior of U.S. trade with industrialized economies such as Japan and Canada follows the J-curve, but not with developing economies such as Mexico.

The Role of the U.S. Dollar in International Trade

Jungho Baek, Kranti Mulik, and Won W. Koo*

INTRODUCTION

The J-curve theory is the traditional wisdom of international economics to analyze the dynamic effect of exchange rate changes on trade balance. It suggests that, following a real depreciation, the trade balance deteriorates in the short-run and improves in the long-run. The response of the trade balance over time resembles a tilted J shape. The rationale behind the J-curve phenomenon is claimed to be the slow adjustment of quantities to changes in relative prices (Magee 1973, Junz and Rhomberg 1973). For example, if there is a depreciation of the domestic currency, then the increased competitiveness of the domestic prices leads to exporting more and importing less, thereby improving the trade balance, which is known as the volume effect. At the same time, the depreciation increases the import unit value and results in a deterioration of trade balance, which is referred to as the value (price) effect. The value effect prevails in the short-run, whereas the volume effect dominates in the long-run, which causes the time path of the trade balance depicted by the J-curve phenomenon.

Agricultural economists have mainly concentrated on the effect of changes in exchange rate on agricultural export volume and/or prices (Gardner 1981, Bessler and Babula 1987, Bradshaw and Orden 1990, Orden 1999). Analyses of the impacts of exchange rate changes on the agricultural trade balance have received little attention. Moreover, given the shrinking U.S. agricultural trade surplus and the decrease in the value of the U.S. dollar during the period of 2002-2004, it is timely and important to explore the effect of exchange rate changes on the trade balance. For example, during the 2002-2004 period, the value of the U.S. dollar decreased by approximately 17% and 10% against the Canadian dollar and the Japanese yen, respectively. In addition, the U.S. dollar declined by approximately 20% against the euro during the three-year period. Despite the decrease in the value of the U.S. dollar, the U.S. agricultural trade surplus continued to deteriorate. The U.S. trade surplus dropped by approximately 34%, from $11.2 billion in 2002 to $7 billion in 2004 (Figure 1).

The objective of this study is to examine the dynamic effect of exchange rate changes on the U.S. agricultural trade balance (i.e., J-curve effect) and to compare the impact on agricultural trade relative to U.S. non-agricultural trade. For this purpose, we use bilateral trade flow data between the United States and her three largest trading partners ─ Canada, Mexico, and Japan ─ and separate the total trade data into trade in agricultural and non-agricultural products.

Canada, Japan, and Mexico account for approximately 40% of U.S. trade in both agricultural and non-agricultural goods. The U.S. agricultural trade balance with Mexico has been relatively stable since 1995, while the trade balance with Japan and Canada has deteriorated over the same period (Figure 2). For example, a $10.1 billion trade surplus with Japan in 1997 decreased to approximately $7.4 billion in 2004. Moreover, during the 1995-2000 period, the trade balance with Canada declined more than a billion dollars and became a $1.3 billion trade deficit in 2000, though it has since increased. In addition, consumer-oriented products account for more than

* Research Assistant Professors, and Professor and Director, respectively, in the Center for Agricultural Policy and Trade Studies, North Dakota State University.

70% of U.S. imports from Canada and Mexico during the 2000-2004 period, while both bulk commodities and consumer-oriented products comprise significant shares of U.S. exports to Japan and Mexico (Table 1). Finally, the U.S. trade deficit in non-agricultural goods with the three countries has substantially increased during the 1996-2004 period (Figure 3). For example, over this period, the U.S. trade deficit with Canada and Japan increased by $57 billion and $24 billion, respectively. Moreover, a $0.8 billion trade surplus with Mexico in 1993 turned into a $63 billion trade deficit in 2004. Machinery and transportation equipment account for the largest share of non-agricultural trade, followed by manufactured goods (Table 2).

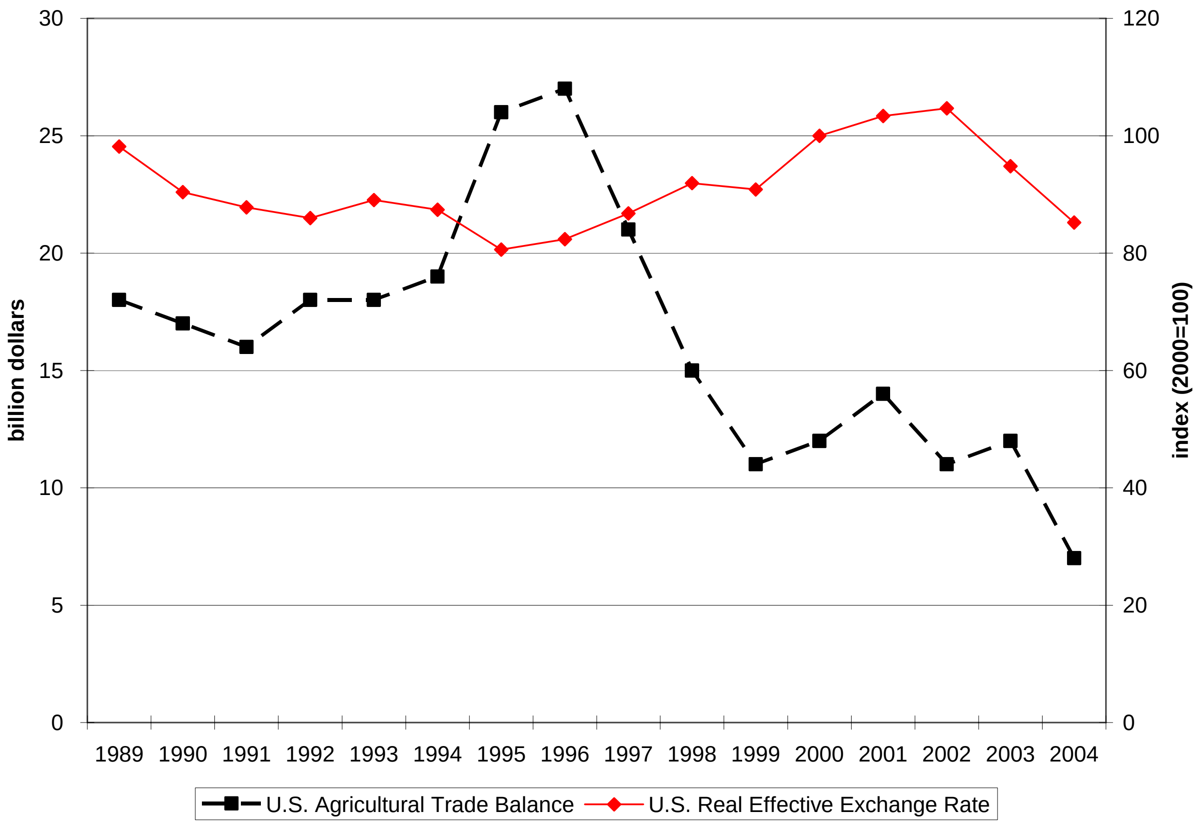

Figure 1. U.S. Agricultural Trade Balance and Effective Exchange Rate
Source: International Financial Statistics (IFS), from the International Monetary Fund (IMF)

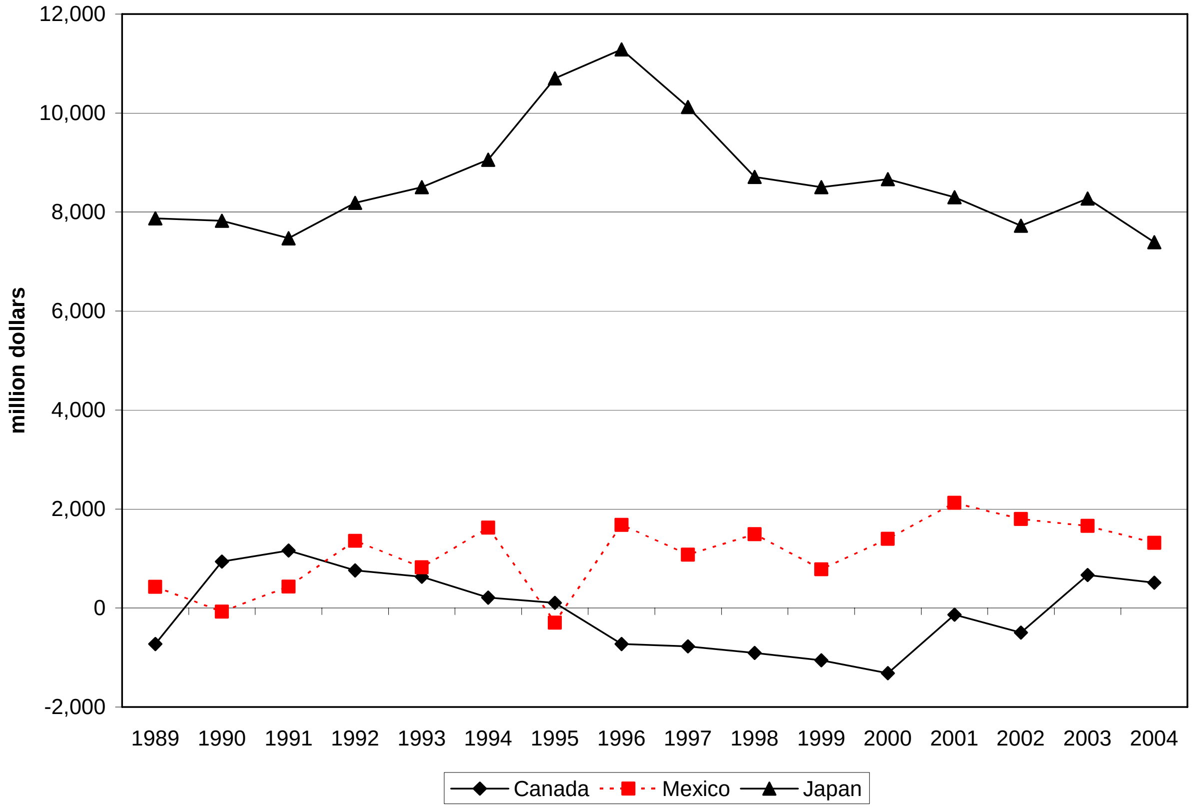

Figure 2. U.S. Agricultural Trade Balance with Canada, Mexico, and Japan
Source: U.S. International Trade Commission

Table 1. U.S. Agricultural Trade, 2000-2004 Average

Export (million dollars)				
Country	Bulk	Intermediate	Consumer-Oriented	Total (%)
Canada	781	1,715	6,199	8,695 (15.6)
Japan	3,439	1,078	4,203	8,720 (15.6)
Mexico	2,861	1,582	3,040	7,483 (13.4)
EU	2,295	1,812	2,473	6,580 (11.8)
Australia	25	156	172	353 (0.6)
China	2,274	644	338	3,256 (5.8)
Total	21,252	12,001	22,501	55,754 (100.0)
Import (million dollars)				
Country	Bulk	Intermediate	Consumer-Oriented	Total (%)
Canada	692	2,540	6,890	10,122 (22.8)
Japan	6	99	278	383 (0.01)
Mexico	257	631	4,997	5,885 (13.3)
EU	178	2,124	7,428	9,730 (21.9)
Australia	65	155	1,750	1,970 (4.4)
China	73	404	630	1,106 (2.5)
Total	5,558	7,930	30,833	44,321 (100.0)

Source: U.S. International Trade Commission.

Note: The Foreign Agricultural Service's (FAS) BICO data classifies agricultural imports and exports into bulk, intermediate, and consumer-oriented products; bulk products include soybeans, wheat, cotton, and other bulk commodities; intermediate group includes products such as soybean oil, wheat flour, vegetable oils and live animals; consumer-oriented products include wine and beer, snack foods, red meats, processed or fresh fruits and vegetables, nursery products, and other processed or ready-to-eat products.

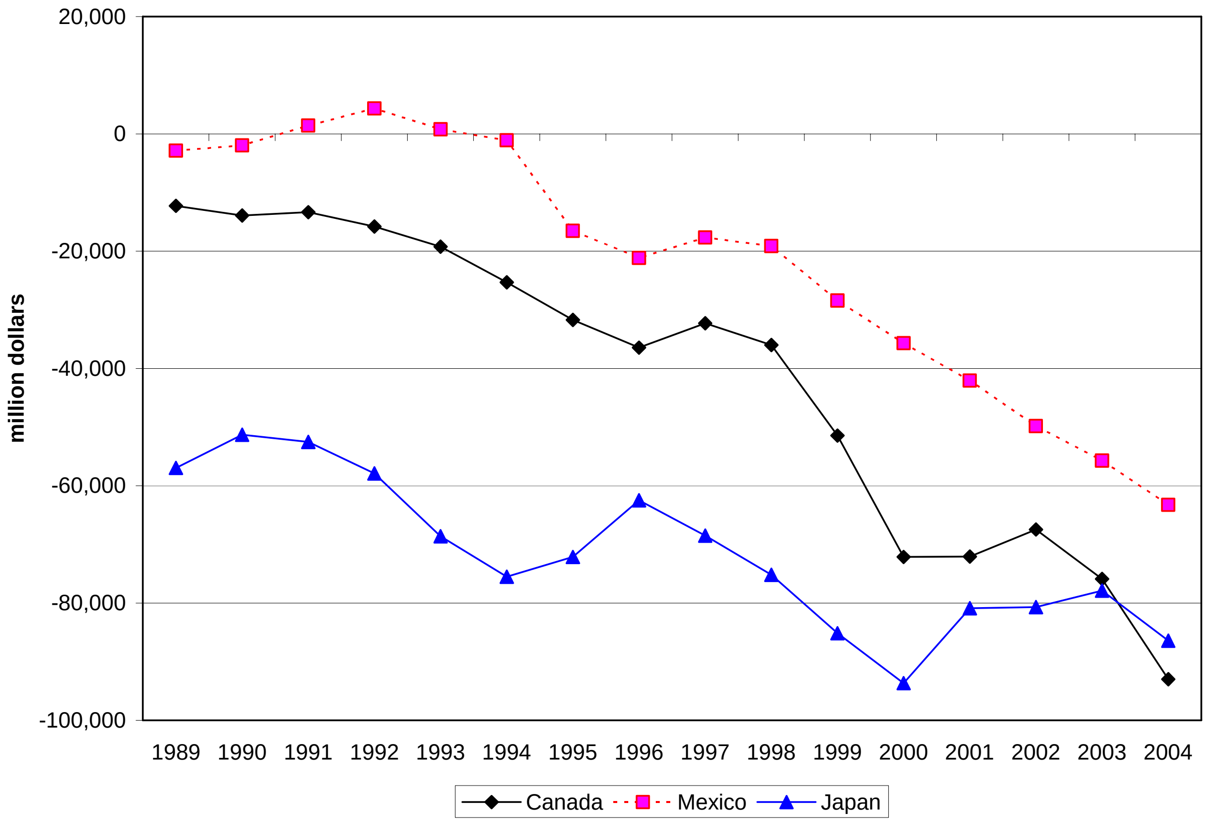

Figure 3. U.S. Non-Agricultural Trade Balance with Canada, Mexico, and Japan
Source: U.S. International Trade Commission

Table 2. U.S. Non-Agricultural Trade, 2000-2004 Average

Exports (million dollars)			
Commodities	Canada	Japan	Mexico
Machinery & transportation equipment	89,650 (55.8)	22,620 (47.7)	51,523 (53.6)
Manufactured goods	23,392 (14.6)	2,891 (6.1)	14,268 (14.8)
Miscellaneous manufactured articles	18,131 (11.3)	8,582 (18.1)	11,622 (12.1)
Chemical and related products	17,203 (10.7)	6,809 (14.4)	9,650 (10.0)
Mineral fuels and related materials	3,765 (2.3)	685 (1.4)	3,411 (3.5)
Others	8,484 (5.3)	5,787 (12.3)	5733 (6.0)
Total	160,625 (100.0)	47,374 (100.0)	96,207 (100.0)
Imports (million dollars)			
Commodities	Canada	Japan	Mexico
Machinery & transportation equipment	88,710 (40.9)	96,924 (75.9)	78,759 (59.4)
Manufactured goods	34,184 (15.8)	7,028 (5.5)	9,782 (7.4)
Miscellaneous manufactured articles	14,866 (6.8)	12,159 (9.5)	20,890 (15.8)
Chemical and related products	13,160 (6.1)	7,352 (5.8)	2,299 (1.7)
Mineral fuels and related materials	37,051 (17.1)	238 (0.2)	13,115 (9.9)
Others	29,049 (13.3)	4,002 (3.1)	7,713 (5.8)
Total	217,020 (100.0)	127,703 (100.0)	132,558 (100.0)

Source: U.S. International Trade Commission.

Note: Non-agricultural commodities are classified by a one-digit SITC code; miscellaneous manufactured articles include furniture and parts (bedding, mattresses, etc.), articles of apparel and clothing accessories, footwear, and photographic apparatus and equipment; others are defined as commodities and transactions not classified elsewhere in the SITC such as coin, gold, and non-monetary.

An autoregressive distributed lag (ARDL) model developed by Pesaran and Shin (1999) and Pesaran et al. (2001) is applied to these data. The ARDL modeling approach has numerous advantages in comparison to standard cointegration methods such as Engle and Granger (1987) and Johansen (1995). First, the ARDL can be applied irrespective of whether the underlying variables are of equal integration (e.g., integrated of order one, or $I(1)$). The model is thus relieved of the burden of pre-testing for unit roots among variables (Pesaran et al. 2001). Second, because a dynamic error-correction model (ECM) can be derived from the ARDL via a simple linear transformation, the ARDL model integrates the short-run dynamics with the long-run equilibrium without losing long-run information. Finally, the ARDL is more robust and performs better for small sample sizes than other cointegration techniques (Pesaran and Shin 1999).

The remainder of this paper is organized as follows. First, we briefly introduce the theoretical framework for the J-curve effect. Next, we describe the empirical models used for our analysis. Then, we present data and empirical procedure, followed by a presentation of our empirical results. Finally, we make some concluding remarks.

THEORETICAL FRAMEWORK

The theories dealing with the exchange rate-trade balance relationship can be classified into three categories: elasticity, absorption, and monetary approaches. In the elasticity approach, the effects of exchange rate changes on the trade balance are determined by the demand and supply elasticities of exports and imports. According to the absorption approach, the trade balance is determined by real national income and its absorption (consumption). Any improvement in the trade balance thus requires an increase of domestic income over total domestic expenditures. In the monetary approach, the trade balance is essentially a monetary phenomenon. Money and asset markets determine the trade balance (i.e., capital account) through changes in supply and demand of the stock of money. In this study, we follow the elasticity approach discussed below. However, we deal directly with the trade balance in the model, instead of analyzing the demand and supply elasticities separately.

Magee (1973) first analyzes the effects of exchange rate changes on the trade balance in the framework of the elasticity approach. He identifies three different periods after a devaluation in which the adjustment of the trade balance is affected by different factors: the currency-contract period, the pass-through period, and the quantity-adjustment period.

The currency-contract period is defined as the brief period immediately after a devaluation in which the export and import contracts are specified before the change. For example, consider the case in which domestic export contracts are denominated in domestic currency and domestic import contracts denominated in foreign currency. In this case, a devaluation of domestic currency increases exchange rate expressed as domestic currency against foreign currency and immediately deteriorates trade balance in the currency-contract period before any price and volume changes.

The pass-through period is defined as the period after a devaluation in which prices can change but quantities of exports and imports remain unchanged. This is also known as the value (price) effect. This effect depends on the scale of demand and supply elasticities of exports and imports. For example, consider the situation in which both domestic and foreign demand for imports are inelastic in the short-run. After a real devaluation, the import price measured in domestic currency increases but the demand stays the same, thereby resulting in an increase of value of imports (i.e., full pass-through). On the other hand, the export price in foreign currency decreases by the same proportion of the exchange rate variation (full pass-through) and the export price in domestic currency remains unchanged. To combine both the currency-contract and the pass-through effects, therefore, the trade balance in domestic currency is expected to decrease following a J-curve pattern before any trade volume changes.

The quantity-adjustment period is defined as the period in which quantities start to adjust in response to changes in prices. This is also known as the volume effect. Under this circumstance, as both export and import elasticities increase (elastic), domestic volume of exports (imports) increases (decreases) in response to the price drop (increase) in foreign (domestic) currency. As a result, the trade balance eventually improves as long as the Marshall-Lerner condition is satisfied ─ the sum of domestic and foreign price elasticities of demand (in absolute value) exceeds one.

Note that in the currency-contract and pass-through periods, there is no logical necessity for a country's trade balance to show the initial portion of the J-curve ─ the deterioration of trade balance in domestic currency (Magee 1973). The necessary conditions for the initial deficit in trade balance are that: (1) domestic export contracts are denominated in domestic currency and import contracts denominated in foreign currency in the currency-contract period and (2) domestic and foreign price elasticities of demand are inelastic and yield full pass-through in the pass-through period.

EMPIRICAL MODELS

To construct the ARDL model, we first derive a trade balance model by relying on a standard bilateral model of trade, as in Rose and Yellen (1989). To that end, the demand for imported commodities at home and in a foreign country is stated as follows:

$$M = M(P_m, Y) \qquad \text{and} \qquad M^* = M^*(P_m^*, Y^*) \tag{1}$$

where M (M^*) is the import volume of the home (foreign) country; P_m (P_m^*) is the relative price of imported goods to domestically produced goods in the home (foreign) country; and Y (Y^*) is the real income of the home (foreign) country. Similarly, the supply of exported commodities at home and in a foreign country is specified as follows:

$$X = X(P_x, Y^*) \qquad \text{and} \qquad X^* = X^*(P_x^*, Y) \tag{2}$$

where X (X^*) is the export volume of the home (foreign) country; and P_x (P_x^*) is the home (foreign) country's relative price of export goods.

The market equilibrium conditions for exports and imports are then:

$$M = X^* \qquad \text{and} \qquad M^* = X \tag{3}$$

Assuming that the law of one price prevails in a perfectly competitive market, we can write $P = ER \times P^*$, where ER is the exchange rate between the domestic and the foreign currency. Given Equations (1)-(3), therefore, the trade balance (TB), defined as the difference between value of exports and value of imports, can be specified as follows:

$$TB = X(Y^*, ER) - M(Y, ER) \tag{4}$$

Finally, in its reduced form, Equation (4) shows the following relationship:

$$TB = TB(Y, Y^*, ER) \tag{5}$$

To illustrate the ARDL modeling approach, we then express Equation (5) in a log linear form as follows:

$$TB_{it} = \alpha + \beta_1 Y_{US,t} + \beta_2 Y_{i,t} + \beta_3 ER_{i,t} + \varepsilon_t \tag{6}$$

where TB_{it} is the U.S. trade balance defined as the ratio of U.S. imports from country i to U.S. exports to country i (expressed as trade deficit), i = Canada, Japan and Mexico; $Y_{US,t}$ is the real U.S. income; $Y_{i,t}$ is the real income of trading partner i; $ER_{i,t}$ is the bilateral real exchange rate between the United States and the currency of trading partner i; and ε_t is the error term.

With regard to the signs of the coefficients in Equation (6), it is expected that $\beta_1 > 0$ and $\beta_2 < 0$, since a rise in U.S. (trading partner) income increases U.S. imports (exports), thereby deteriorating (improving) the trade balance. However, if an increase in U.S. (trading partner) income is a result of a rise in production of import-substitute commodities, U.S. imports (exports) may decline as U.S. (trading partner) income increases. In this case, it is expected that $\beta_1 < 0$ and $\beta_2 > 0$. As to the effect of exchange rate, it is expected that $\beta_3 > 0$, since the depreciation of the U.S. dollar increases exports and decreases imports, thereby improving the trade balance.

The ARDL approach involves estimating the error correction version of the ARDL model for variables under estimation. From Equation (6), the ARDL model of interest then can be written as follows:

$$\Delta TB_{i,t} = a_0 + a_1 t + b_1 TB_{t-1} + b_2 x_{t-1} + \sum_{i=1}^{p-1} \Psi_i \Delta z_{t-i} + \delta \Delta x_t + \varepsilon_t \tag{7}$$

where $z_t = [TB_{i,t}, Y_{US,t}, Y_{i,t}, ER_{i,t}] = [TB_{i,t}, x_t]$; Δ is the difference operator; p is lag order; and ε_t is assumed serially uncorrelated. Equation (7) is called the error correction version related to the ARDL since the linear combination of lagged variables (b_1 and b_2) replaces the lagged error-correction term in a standard error-correction model (ECM). Hence, b_1 and b_2 represent the long-run (cointegration) relationship. On the other hand, Ψ and δ provide the short-run relationship between trade balance and its main determinants (i.e., the J-curve effect).

DATA AND EMPIRICAL PROCEDURE

Data

The aim of this study is to employ disaggregate data on a bilateral basis to examine the impact of exchange rate changes on agricultural trade relative to trade in other sectors between the United States and her trading partners. For this purpose, using the U.S. International Trade Commission (USITC) Trade Dataweb classified by the Ag-NonAg code, we identify the U.S. trade balance in two broad sectors: agricultural and non-agricultural. The data contains 64 quarterly observations for 1989-2004. All variables are converted to natural logarithms.

The total values of exports and imports for agricultural and non-agricultural products between the United States and her three major trading partners ─ Canada, Mexico, and Japan ─ are obtained from the ITC Trade Dataweb. The U.S. trade balance is then defined as the ratio of U.S. imports to U.S. exports for agricultural and non-agricultural products with the three trading partners (expressed as trade deficit). One of the major reasons for using the ratio is that it is not sensitive to the units of measurement and can be interpreted as real trade balance. In addition, the ratio can narrow the range of the variable to make it less susceptible to outlying or extreme observations (Wooldridge 2000). Finally, the ratio can be transformed into a logarithmic form without being concerned about possible negative values.

The real gross domestic production (GDP) is used as a proxy for the real income and is taken from the International Financial Statistics (IFS) published by the International Monetary Fund

(IMF). The GDP deflator obtained from the IFS is used to derive real GDP (2000=100). The bilateral real exchange rate is also obtained from the IFS. Since the exchange rate is expressed as the number of trading partner's currency per unit of the U.S. dollar, a decline in exchange rate indicates a real depreciation of the U.S. dollar.

Empirical Procedure

The ARDL modeling procedure starts with determining the lag length (p) in Equation (7). To that end, we use the Akaike Information Criterion (AIC) and Lagrange multiplier (LM) statistics for testing the hypothesis of no serial correlation against orders 1 and 3, respectively (Table 3). For example, the AIC indicates that lag 5 ($p_{aic} = 5$) is the appropriate lag length for the agricultural trade between the United States and Canada. However, the LM statistics show that the null of no serial correlation can be rejected at $p_{aic} = 5$ and even $p_{aic} = 4$, which gives the second-highest AIC statistic. We then select lag 2 ($p = 2$), which provides the third-highest AIC statistic as well as the acceptance of no serial correlation. For non-agricultural trade, on the other hand, both the AIC and LM test consistently indicate $p = 2$ (Table 3). Likewise, $p = 3$ is the most appropriate lag length for both agricultural and non-agricultural trade between the United States and Japan. For U.S.-Mexico trade, $p = 2$ and $p = 4$ are selected for agricultural and non-agricultural trade, respectively.

Table 3. A Partial Summary of Statistics for Selecting the Lag Order and F-statistics of the Existence of a Level Trade Balance Equation with Canada

Trade Balance	Lag order	1 lag	2 lags	3 lags	4 lags	5 lags
Agricultural Trade Balance	AIC	-2.62	-2.61	-2.62	-2.56	-2.54
	$\chi^2_{SC}(1)$	0.15	1.47	0.02	2.77	11.47**
	$\chi^2_{SC}(3)$	1.83	2.33	2.48	9.41*	12.07**
	F -statistic	8.45	4.73	2.93	3.04	3.76
Non-Agricultural Trade Balance	AIC	-4.19	-4.16	-4.17	-4.66	-4.67
	$\chi^2_{SC}(1)$	2.42	0.01	19.93**	1.61	2.67
	$\chi^2_{SC}(3)$	3.91	0.54	21.85**	2.52	9.23*
	F -statistic	5.13	4.63	2.84	5.82	4.77

Note: **, and * denote significance at 5%, and 10% levels, respectively; AIC represents Akaike Information Criterion for a given lag length; $\chi^2_{SC}(1)$ and $\chi^2_{SC}(3)$ are LM statistics for testing no serial correlation against orders 1 and 3; the F -statistics for 10% and 5% critical value bounds are (2.72, 3.77) and (3.23, 4.35), respectively; the critical values are from Table CI in Pesaran et al. (2001).

We then test the existence of a level relationship (cointegration) among variables (TB_{t-1}, x_{t-1}) using the selected ARDL model. For this purpose, the null hypothesis of no level relationship, namely ($b_1 = b_2 = 0$) in Equation (7) is tested, irrespective of whether the regressors are purely $I(0)$, purely $I(1)$, or mutually cointegrated. This can be done using an F -test with two sets of asymptotic critical values tabulated by Pesaran et al. (2001) in which all the regressors are assumed to be purely $I(0)$ or purely $I(1)$. This is called a bounds testing procedure since the two sets of critical values provide critical value bounds for all possibilities of the regressors into purely $I(0)$, purely $I(1)$, or mutually cointegrated (Pesaran et al. 2001, p.290). If the computed F-statistic lies outside the upper level of the critical bounds, the null can be rejected, indicating that the variables are cointegrated. If the F-statistic falls below the lower level of the critical bounds, on the other hand, the null cannot be rejected, supporting lack of cointegration.

For example, with $p = 2$ for the agricultural trade, the F-statistic is 4.73, which lies outside the upper level of the 5% critical bounds (Table 3). As a result, the null hypothesis that there exists no cointegrated trade balance equation can be rejected, irrespective of whether the regressors are purely $I(0)$, purely $I(1)$, or mutually cointegrated. In addition, with $p = 2$ for the non-agricultural trade, the hypothesis of no cointegrated trade balance equation is conclusively rejected at the 5% significance level. Overall, our results support the existence of cointegrated trade balance equations when using $p = 2$ for the agricultural and non-agricultural trade between the United States and Canada.

Similarly, the F-statistics are 6.71 ($p = 3$) for the non-agricultural trade with Japan and 9.63 ($p = 2$) for the agricultural trade with Mexico, which lie above the 5% upper bound. However, the test results for the agricultural trade with Japan and the non-agricultural trade with Mexico are 2.87 ($p = 3$) and 2.95 ($p = 4$), respectively, which fall within the 10% bound. If the F-statistic lies between the two bounds, the inference is inconclusive. In these cases, the error-correction terms in the ARDL model are used to determine the existence of cointegrated trade balance equations. Hence, if a negative and significant lagged error-correction term is obtained, the variables are said to be cointegrated.

EMPIRICAL RESULTS

Our results are divided into long- and short-run analyses in this section. The long-run analysis focuses on analyzing the existence of cointegration relationship between the trade balance and other macroeconomic variables, while the short-run analysis concentrates on estimating the short-run dynamic effects of the depreciation on the trade balance (J-curve effect).

Results of Long-Run Analysis

The long-run trade balance model in Equation (6) is estimated to identify the cointegration relationship among variables (Table 4). The results show that the U.S. trade balance has a positive long-run relationship with real exchange rates for the agricultural and non-agricultural trade with the three countries. This suggests that the depreciation of the U.S. dollar indeed improves the trade balance in the long-run. The U.S. trade balance with Japan has a positive long-run relationship with real domestic income and a negative relationship with real foreign income for the agricultural and non-agricultural trade. This indicates that a rise in real U.S. (foreign) income increases domestic (foreign) demand for foreign imports (domestic exports), thereby deteriorating (increasing) the trade balance.

On the other hand, the U.S. trade balance with Canada has a negative long-run relationship with domestic income and a positive relationship with foreign income for both cases. This suggests that an increase of real domestic (foreign) income decreases domestic (foreign) demand for foreign imports (domestic exports), thereby improving (deteriorating) the trade balance. In other words, since imports are defined as the difference between domestic consumption and production, an increase in domestic income could increase the domestic production of import-substitute commodities faster than a rise in domestic consumption, which thus leads to the reduction of domestic imports (Magee 1973, Bahmani-Oskooee 1985, Bahmani-Oskooee and Ratha 2004). Finally, the U.S. trade balance with Mexico has a positive (negative) relationship with domestic income and a negative (positive) relationship with foreign income for the non-agricultural (agricultural) trade. However, most cases are not statistically significant.

Table 4. Estimated Long-Run Coefficients of the Bilateral Trade Balance Model

Country i	Trade balance	EX_i	Y_{US}	Y_i	Constant
Japan	Agricultural Trade Balance	2.78 (3.92)**	2.13 (12.50)**	-2.87 (-4.96)**	19.68 (1.97)*
	Non-Agricultural Trade Balance	1.56 (4.58)**	0.51 (6.19)**	-1.29 (-4.63)**	19.94 (4.13)**
Canada	Agricultural Trade Balance	2.49 (2.86)**	-1.43 (-1.99)**	1.24 (1.77)*	5.24 (2.03)**
	Non-Agricultural Trade Balance	1.14 (6.04)**	-0.72 (-4.61)**	1.10 (7.25)**	-3.54 (-6.32)**
Mexico	Agricultural Trade Balance	0.80 (1.64)*	-0.11 (0.93)	0.04 (0.10)	-0.81 (-0.05)
	Non-Agricultural Trade Balance	0.55 (5.61)**	1.10 (4.19)**	-0.12 (-1.61)	-17.15 (-5.42)**

Note: **, and * denote significance at 5% and 10% levels, respectively.

Results of Short-Run Analysis: Does the J-curve exist?

The error correction version of the ARDL model associated with the above cointegration relationship (Equation (7)) is estimated to capture the short-run dynamic effects of the depreciation on the trade balance or the J-curve effect (Table 5). The sign of the coefficient of the exchange rate determines the existence of the J-curve effect. That is, an initially negative sign followed by a positive one on the lag coefficients would be consistent with the J-curve phenomenon. The results of the agricultural trade show that all the coefficients of the current and lagged exchange rate (except for the current lag of Mexico) are not statistically significant. Thus, the findings indicate that there is no J-curve effect for the U.S. agricultural trade with Japan, Canada, and Mexico.

Because our analysis is based on the elasticity approach, one possible explanation for no evidence of the J-curve for agricultural goods is that the necessary condition for the J-curve in the currency-contract period may not hold for the U.S. agricultural trade; U.S. export contracts should be denominated in dollars and U.S. imports contracts denominated in foreign currency. However, such an explanation may not be conclusive in view of the fact that the currency-contract analysis deals with a very brief period immediately following a devaluation and because the currency in which prices are quoted presumably would be changed to avoid an exchange rate loss (Magee 1973). Even though the agricultural industry is characterized by contracts that do not change subsequent to a real depreciation, currency and future markets tend to mitigate the effects of exchange rate variability on agricultural trade. Moreover, it is not likely to find qualitative or survey evidence on the currency denomination of U.S. (agricultural) trade.

Table 5. Coefficient Estimates of Exchange Rate and Error-Correction Term based on Autoregressive Distributed Lag Model (ARDL)

Country	Trade balance	DEX	DEX_{t-1}	DEX_{t-2}	DEX_{t-3}	DEX_{t-4}	ec_{t-1}
Japan	Agricultural	-0.41	-0.17	-0.06	0.01		-0.16*
	Trade Balance	(-1.15)	(-0.51)	(-0.18)	(0.04)		(-1.83)
	Non-Agricultural	-2.97**	-2.60**	-0.17	1.73*		-0.38**
	Trade Balance	(-2.68)	(-2.75)	(-0.18)	(-1.65)		(-2.53)
Canada	Agricultural	0.94	2.97	-0.79			-0.58**
	Trade Balance	(0.44)	(1.22)	(-0.34)			(-3.61)
	Non-Agricultural	-1.56**	-1.70**	1.08*			-0.53**
	Trade Balance	(-2.57)	(-2.42)	(1.69)			(-2.97)
Mexico	Agricultural	2.54**	-0.79	0.16			-0.14**
	Trade Balance	(2.72)	(-0.84)	(0.16)			(-4.40)
	Non-Agricultural	0.13	0.05	0.43**	-0.06	-0.42*	-0.46**
	Trade Balance	(0.68)	(0.33)	(2.54)	(-0.34)	(-1.96)	(-3.74)

Note: **, and * denote significance at 5% and 10% levels, respectively.

Thus, the most likely explanation for the finding is that U.S. agricultural trade may not meet the necessary condition for the pass-through effect, which is that U.S. and foreign price elasticities of demand are inelastic. In fact, in the short-run, supply of U.S. agricultural exports is generally inelastic, while demand is relatively elastic due to the availability of other major exporters such as Australia and the EU (Table 1). Under this circumstance, as a consequence of a depreciation, the dollar price of U.S. exports increases but the dollar price of U.S. imports remains unchanged (i.e., no pass-through). As a result, the U.S. agricultural trade does not show the initial deterioration of the trade balance.

On the other hand, for the U.S. non-agricultural trade with Japan and Canada, the signs of the coefficients of current and one-period lagged exchange rate are negative and statistically significant at the 5% level. These negative signs are followed by positive signs, which are statistically significant at the 10% level. This implies that after the devaluation of the U.S. dollar, the non-agricultural trade balance deteriorates for at least two quarters before it starts improving. In other words, the behavior of the U.S. non-agricultural trade with Canada and Japan follows the J-curve pattern.

U.S. non-agricultural trade with industrialized economies such as Canada and Japan has been mainly characterized as intra-industry trade based on imperfect competition and product differentiation (e.g., quality, location, size, and so on). For example, transportation equipment (i.e., road vehicle) is the largest U.S. export to Canada but also the top U.S. import from Canada (Table 2). In this case, demand is generally inelastic since products are greatly differentiated and consumers do not tend to switch easily between differentiated products in response to short-term changes in prices. Hence, the dollar price of U.S. exports remains unchanged and the dollar price of U.S. imports rises by almost the full amount of the devaluation (i.e., full pass-through), thereby contributing to the initial decline in the trade balance.

In contrast, for the U.S. non-agricultural trade with Mexico, the signs of the coefficients of current and two-period lagged exchange rate are positive, followed by negative signs, indicating the reversed J-curve phenomenon. However, most coefficients are not statistically significant. The result thus indicates that there is no J-curve effect for the U.S. trade with Mexico.

One possible explanation for the finding is that U.S.-Mexico trade is characterized as both inter- and intra-industry trade: transportation equipment and textiles and apparel represent approximately 75% of U.S. imports from Mexico (Table 2). In this case, as compared to U.S. trade with industrialized economies, demand is relatively more elastic because of the availability of supplies from other developing countries (i.e., China). Hence, the dollar price of U.S. imports would not be driven by the full amount of the depreciation (i.e., no pass-through) and the initial deterioration of the trade balance does not occur. Another possible explanation for the finding is that U.S.-Mexico trade does not meet the necessary condition for the currency-contract effect (Hsing 2005). Since both exports and imports in small economies such as Mexico are denominated in foreign currency (mostly the U.S. dollar), the dollar prices of U.S. exports and imports remain unchanged after real depreciation. As a result, the U.S. non-agricultural trade does not show the initial decline in the trade balance.

Finally, it should be pointed out that all the error-correction terms in all cases are negative and statistically significant at least at the 10% level. The findings thus justify the ARDL modeling of the U.S. agricultural trade with Japan and the U.S. non-agricultural trade with Mexico in which the results of the F -statistics are inconclusive.

CONCLUSIONS

This study examines whether there is a J-curve effect for the U.S. agricultural trade and compares the effect on agricultural trade relative to the U.S. non-agricultural trade. The rationale behind the J-curve effect is that the trade volume effect supersedes the price effect, so that import (export) value increases over export (import) value in the short (long)-run. The ARDL model is used to estimate bilateral trade data involving trade flows between the United States and her three major trading partners ─ Canada, Japan, and Mexico ─ for 1989:1-2004:4.

We find little evidence that there is a J-curve effect for U.S. agricultural trade with Canada, Japan, and Mexico. For the non-agricultural trade, on the other hand, the behavior of U.S. trade with industrialized economies such as Japan and Canada follows the J-curve, but not with developing economies such as Mexico.

Our findings are important in understanding the recent deterioration of U.S. external trade balance. First, the recent depreciation of the U.S. dollar will have a favorable impact on U.S. non-agricultural trade with industrialized economies such as Canada and Japan, and may improve its competitive position in non-agricultural trade in the short-run. Second, for U.S. agricultural trade, a change in the value of the U.S. dollar is not a significant factor influencing its trade balance in the short-run. This further suggests that the shrinking agricultural trade surplus for the recent periods cannot be explained by the J-curve effect, indicating that the recent depreciation of the dollar will not improve its agricultural trade balance. Finally, although the short-run responses of the trade balance in agricultural and non-agricultural goods to the U.S. dollar depreciation do not follow any consistent pattern, the long-run effects support that the depreciation of the U.S. dollar improves the U.S. trade balance and vice versa.

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