A Study of the J-Curve for Seven Selected Latin American Countries

Yu Hsing*

Southeastern Louisiana University

Abstract This study finds that there is evidence of a J-curve for Chili, Ecuador, and Uruguay and lack of support for a J-curve for Argentina, Brazil, Colombia, and Peru. Increased real income in the home country would improve the trade balance for Brazil and Ecuador and deteriorate the trade balance for Argentina, Chili, Colombia, Peru, and Uruguay. Increased real income in the U.S. would improve the trade balance for Argentina, Chile, Colombia, Peru, and Uruguay and deteriorate the trade balance for Brazil and Ecuador. Hence, the conventional wisdom to pursue real depreciation to improve the trade balance may not apply to some of these countries.

Keywords: J-curve, trade balance, real exchange rate, VECM, generalized impulse response function

JEL Classification: F14, F31

1. Introduction

This paper examines the J-curve for seven selected South Latin American countries. A J-curve postulates that after real depreciation or devaluation, the trade balance is expected to deteriorate at first, then improve because the increased value of imports initially would dominate the increased volume of exports, and increased volume of exports would outweigh the increased value of imports later. The analysis is important in light of the recent South American experience. For example, during 1997-2002, the Brazilian real per U.S. dollar experienced real depreciation, declining from 1.164 to 2.633. The trade balance improved from a deficit of 20,658 millions to a surplus of 22,369 millions, and the ratio of exports to imports rose from 75.61% to 112.03%. During 2002-2007, the Brazilian real per U.S. dollar experienced real appreciation and changed from 2.633 to 1.430. However, the trade balance continued to increase from 22,369 millions to 39,112 millions, and the ratio of exports to imports changed little from 112.03% to 112.38%. Our analysis suggests that there is no J-curve for Brazil which is consistent with their experience of no real difference between the long and short run adjustments.

During 2001-2002, Argentina’s real exchange rate in terms of the peso per U.S. dollar depreciated considerably from 1.039 to 2.570. As a result, the trade balance improved from 3,509 millions to 46,926 millions, and the ratio of exports to imports increased from 112.71% to 212.28%. During 2002-2007, Argentina’s peso per U.S. dollar experienced real appreciation
from 2.570 to 1.910. The trade balance declined to 34,866 million, and the ratio of exports to imports decreased to 121.21%. Our study indicates that there is lack of support for a J-curve for Argentina due to positive adjustments in the short run and negative adjustments in the long run.

The real effective exchange rate (an increase means real appreciation) for Colombia changed from 82.54 in 1990 to 128.08 in 1997, 84.89 in 2003, and 103.65 in 2006. The trade balance deteriorated from a surplus of 708.29 billions in 1990 to a deficit of 7,197.7 billions in 1997, a deficit of 1,071.2 billions in 2003, and a deficit of 7,885.3 billions in 2006. It seems that the recent real appreciation from 84.89 to 103.65 hurt net exports significantly. Our investigation shows that there is lack of evidence of a J-curve for Colombia due to positive adjustments in the short run and negative adjustments in the long run. Other countries show different responses of the trade balance to real depreciation or appreciation.

A few points are worth noting. First, some of the previous studies rely on aggregate trade data of total exports and total imports, rather than using bilateral trade data between two countries. The use of bilateral trade data for each of the South American countries analyzed here and the U.S. provides more detailed estimates. Second, most of previous studies use conventional regression analysis to find parameter estimates and elasticities of the trade balances with respect to real depreciation and other relevant variables, whereas this paper applies time series techniques such as the vector-error correction model, the generalized impulse response function, and the cointegrating equation to determine how the trade balance would react to a shock to real depreciation in both the short run and long run. Third, this study uses the most recent bilateral trade data in order to provide policy makers with up-to-date empirical results for consideration and application in their decision-making processes.

The paper is organized as follows. The literature related to the J-curve for these countries is surveyed in the second section. The theoretical model of the trade balance is presented in the third section. Data sources and empirical results are described and analyzed in the fourth section. A summary and conclusions are made in the last section.

2. Literature Survey

Economists have extensively examined the relationship between the real depreciation or devaluation of a domestic currency and the improvement or deterioration of a country’s trade balance. Miles (1979) shows that real devaluation does not improve the trade balance but improves the balance of payment. He also demonstrates that there is lack of evidence of the J-curve for Ecuador, Guyana, and 12 other countries. Himarios (1985) finds that real devaluation improves the trade balance for Ecuador and 8 other countries. Rose (1990) examines the impact of real depreciation on the trade balance for 30 developing countries and finds lack of evidence that real depreciation would lead to an improved trade balance for Argentina, Brazil, Chile, Colombia, Peru, and Uruguay.

Bahmani-Oskooee and Malixi (1992) find evidence of a J-curve for Brazil and lack of support for a J-curve for Peru. They also find that several other shapes, such as the I-, M-, and N-curves, characterize the response of the trade balance to real depreciation in the short run and that real
depreciation would lead to improved trade balance in 8 countries, including Brazil and Peru, in the long run. Bahmani-Oskooee and Alse (1994) study the J-curve effect for 22 LDCs and find that there is lack of evidence of a J-curve for Argentina, Brazil, Colombia, and Ecuador. Bahmani-Oskooee and Ratha (2004b) show that if a new definition (Rose and Yellen, 1989) of the J-curve is adopted, there would be a J-curve in 7 out of 13 countries including Argentina and Chile. Bahmani-Oskooee and Ratha (2004a) provide a detailed review of major previous studies.

3. The Model

Let’s denote $P$, $P^*$, $e$, $eP^*$, and $E$ as export price in domestic currency, import price in foreign currency, the domestic price of a unit of foreign exchange, import price in domestic currency, and the real exchange rate or $eP^*/P$. Applying and extending Rose and Yellen (1989) and Rose (1990), exports, imports, the real trade balance can be expressed as:

\[ X = X(E,Y^*) \]  
\[ M = M(E,Y) \]  
\[ TB = X - EM = X(E,Y^*) - EM(E,Y) \]

or

\[ TB = TB(E,Y,Y^*) \]

where

$X$ = exports,  
$M$ = imports,  
$TB$ = the real trade balance,  
$Y^*$ = real income in the U.S., and  
$Y$ = real income in the home country.

The partial derivative of the real trade balance with respect to real depreciation is given by:

\[ \frac{\partial TB}{\partial E} = \frac{\partial X}{\partial E} - E\frac{\partial M}{\partial E} - M > 0 \text{ or } 0. \]  
\[ (5) \]

It can be shown that if $TB = 0$, equation (5) will be reduced to the Marshall-Lerner condition. The sign of equation (5) depends on whether the volume effect of increased exports would be greater or less than the value effect of imports (Krugman and Obstfeld, 2003).

The sign of $\frac{\partial TB}{\partial Y}$ in equation (4) is unclear because higher real income in the home country may increase imports, leading to a deterioration of the trade balance, or reduce imports due to growth in import-substitute production. The sign of $\frac{\partial TB}{\partial Y^*}$ in equation (4) is also ambiguous because higher real income in the U.S. may increase exports to the U.S. from her trading partners.
or reduce imports from her trading partners due to growth in import-substitute production in the U.S.

To measure the elasticity of the trade balance with respect to the real exchange rate, real income in the home country, and real income in the U.S., equation (4) can be expressed as a log-log equation:

\[ \ln \text{TB}_t = \alpha_1 + \alpha_2 \ln \text{E}_g + \alpha_3 \ln \text{Y}_t + \alpha_4 \ln \text{Y}_t^* \]  

(6)

where \( \alpha_2 \) measures the elasticity of the trade balance with respect to the real exchange rate, \( \alpha_3 \) denotes the elasticity of the trade balance with respect to real income in the home country, and \( \alpha_4 \) represents the elasticity of the trade balance with respect to real income in the U.S.

4. Empirical Results

The data for the exchange rate, real income in the home country, real income in the U.S., and relative prices were taken from *International Financial Statistics*, a publication of the International Monetary Fund. Exports to and imports from the U.S. were collected from *Direction of Trade Statistics*, also published by the International Monetary Fund. For Brazil, nominal exports and imports are divided by the export and import price indexes and expressed in real terms. The trade balance is measured as the log of real exports divided by real imports. The real exchange rate is equal to the nominal exchange rate expressed as units of the home currency per U.S. dollar times the price in the U.S. and divided by the price in the home country. Hence, an increase in the real exchange rate is real depreciation of the home country currency. The consumer price index is used for the price level. Real GDP in index number is selected to represent real income in the home country or the U.S., with the exception that industrial or manufacturing production index is used for Brazil and Uruguay due to lack of quarterly data for real GDP. Venezuela and Paraguay are not included due to lack of quarterly data for real output or industrial production. Sample periods vary by country and are reported in the table for estimated cointegrating equations. The main reason why the same sample period is not used is because statistical tests for some countries would be affected adversely due to relatively small sample sizes. The unit root test indicates that all the variables have unit roots in level and are stationary in first difference.

Table 1 presents the cointegration test based on the maximum eigenvalue test. As shown, the null hypothesis that there is no cointegrating relationship for each of the countries can be rejected at the 5% level.

Table 2 presents the estimated long-run cointegrating equations. As shown, the trade balance is positively affected by real depreciation for Argentina, Brazil, Ecuador, Peru, and Uruguay, negatively associated with real depreciation for Chile, and is not influenced by real depreciation for Colombia due to the insignificant coefficients. Real income in the home country has a positive impact on the trade balance for Brazil and Ecuador and a negative impact on the trade balance for Argentina, Chile, Colombia, Peru, and Uruguay. Real income in the U.S. has a
positive effect on the trade balance for Argentina, Chile, Colombia, Peru, and Uruguay and a negative effect on the trade balance for Brazil and Ecuador.

Graph 1 presents the estimated generalized impulse response function for each of the countries. There are several patterns. The first pattern is the J-curve that can be observed for Chile, Ecuador, and Uruguay. In responding to real depreciation, it takes just one quarter for the trade balance in Chile to change from a negative to a positive value, and it takes 2 quarters for the trade balance in Ecuador to change from a negative value to a positive value. The second pattern is the complete negative response of the trade balance to real depreciation for Peru. The third pattern is the initial positive response of the trade balance to real depreciation and the negative response later for Argentina and Colombia. The fourth pattern is the positive response (though with the exception of some negative response) for Brazil in the fifth quarter.

In comparison, the results in this paper are different from Miles (1979) for Ecuador, similar to Himarios (1985) for Ecuador in the long run, different from Rose (1990) for Argentina, Brazil, and Uruguay and similar to Rose (1990) for Chile, Colombia, and Peru in the long run. The findings of this paper are similar to Bahmani-Oskooee and Malixi (1992) for Brazil and different from Bahmani-Oskooee and Malixi (1992) for Peru, similar to Bahmani-Oskooee and Alse (1994) for Argentina, Brazil, and Colombia and different from Bahmani-Oskooee and Alse (1994) for Ecuador, similar to Bahmani-Oskooee and Ratha (2004b) for Chile and different from Bahmani-Oskooee and Ratha (2004b) for Argentina. Possible reasons for different results are the use of different models, econometric methodologies, data, and sample periods.

5. Summary and Conclusions

This paper has examined the J-curve of the bilateral trade between the U.S. and her seven South American trading partners including Argentina, Brazil, Chile, Colombia, Ecuador, Peru, and Uruguay. The vector-error correction model and the generalized impulse response function were applied and estimated in order to measure the response of the trade balance to a shock to real depreciation. The cointegrating equation was estimated to determine the long-run relationship between the trade balance and real depreciation, real income in the home country, and the real income in the U.S.

Major findings are summarized as follows. The trade balance for Argentina has a positive relationship with real depreciation and real income in the U.S. and a negative relationship with own real income in the long run. There is lack of support for a J curve. The impulse response function shows that real depreciation leads to a trade surplus in the first 7 quarters and a trade deficit afterward. Therefore, in Argentina, real depreciation generates different impacts on trade balance in the short run and in the long run.

The balance of trade for Brazil is positively associated with real depreciation and own real income and negatively influenced by real income in the U.S. in the long run. There is lack of support for a J curve. The impulse response function shows that real depreciation leads to a trade surplus initially, a trade deficit in the fifth quarter, then a trade surplus afterward. Hence, real depreciation would lead to improvement in the trade balance except for one quarter.
For Chile, real depreciation is negatively affected by real depreciation and own real income and positive influenced by real income in the U.S. in the long run. There is evidence of a J curve. These results suggest that after real depreciation, there would be a trade deficit initially, then a trade surplus afterward. Higher real income in the U.S. would also improve the trade balance.

The trade balance for Colombia is not affected by real depreciation, has a negative relationship with own real income, and has a positive relationship with real income in the U.S. in the long run. There is no evidence of a J curve because the trade balance improves initially and deteriorates later. Thus, the positive impact of real depreciation on the trade balance is short-lived. Higher real income in the U.S. would improve the trade balance.

For Ecuador, real depreciation and higher own real income would improve the trade balance whereas higher real income in the U.S. would deteriorate the trade balance in the long run. Like Chile, there is support for a J curve. With real depreciation, the trade balance deteriorates in the first quarter and improves afterward. Therefore, real depreciation may be a useful policy tool to improve net exports.

The trade balance for Peru is negatively affected by real depreciation and own real income and positively associated with real income in the U.S. in the long run. There is no evidence of a J curve because real depreciation leads to a trade deficit. Hence, to improve the trade balance, real appreciation instead of real depreciation should be considered.

Like Argentina, the trade balance for Uruguay is positively affected by real depreciation and real income in the U.S. and negatively associated with own real income in the long run. Like Chile and Ecuador, there is support for a J curve for Uruguay. Real depreciation would lead to deterioration in the trade balance in the first four quarters and a subsequent improvement in the trade balance.

In view of the broad range of empirical results, these countries may need to exert caution in pursuing the exchange rate policy. For example, real depreciation would deteriorate the trade balance for Peru in the short run and long run whereas real depreciation would improve the trade balance for Ecuador after the first quarter and Uruguay after the 4th quarter.

There are may be areas for future research. In the selection process of the lag length, there may be different empirical outcomes when the lag length is changed slightly due to the use of different criteria. The outcomes of the generalized impulse response function and the cointegrating equation may not be consistent partly due to the multicollinearity problem (Bahmani-Oskooee and Malixi, 1992). The choice of different methods in estimating the impulse response function may also lead to different results.
Endnote

* Department of Business Administration, College of Business, Southeastern Louisiana University, Hammond, LA 70402. E-Mail: yhsing@selu.edu. I appreciate insightful comments from the referee and the editor. Any errors are the author’s sole responsibility.

References


Table 1. The Johansen Cointegration Test

<table>
<thead>
<tr>
<th>Hypothesized No. of CE(s)</th>
<th>Max-Eigenvalue</th>
<th>Max-Eigen Statistic</th>
<th>0.05 Critical Value</th>
<th>Prob.**</th>
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<td>0.0161</td>
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<td>25.82321</td>
<td>0.1072</td>
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Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Table 2. Estimated Cointegrating Equations by Normalizing on ln TB

<table>
<thead>
<tr>
<th>Country</th>
<th>ln E</th>
<th>ln Y</th>
<th>ln Y*</th>
<th>Constant</th>
<th>Sample period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chile</td>
<td>-1.060 (-1.897)</td>
<td>-5.274 (-4.626)</td>
<td>9.876 (4.531)</td>
<td>-14.258</td>
<td>1980.Q4-2007.Q3</td>
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<td>Colombia</td>
<td>0.129 (0.571)</td>
<td>-3.559 (-5.289)</td>
<td>4.083 (6.700)</td>
<td>-2.976</td>
<td>1995.Q1-2007.Q3</td>
</tr>
</tbody>
</table>

Notes:

The dependent variable is the trade balance (TB) defined as log(X/M), where X and M are exports and imports.
E is the real exchange rate.
Y is real income in the home country.
Y* is real income in the U.S.
Figures in the parenthesis are t statistics.
Graph 1. Impulse Response Function

Argentina  

Brazil  

Chile  

Colombia  

Ecuador  

Peru  

Uruguay

Notes:  

TB = the trade balance, and  
E = the real exchange rate.