E c o n o m i c s B u l l e t i n

Is there a J-Curve at the Industry Level?

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Abstract

There exits two groups of studies that have investigated the short-run and the long-run effects of currency depreciation on the trade balance. The first group has employed trade data at the aggregate level between one country and the rest of the world. The second group has used trade data at the bilateral level between one country and her major trading partners. Both groups have provided mixed conclusions. In this paper we employ import and export data at industry level. Sixty six industries in the U.S. (SITC Commodity Groupings) have been identified for which monthly data over the January 1991-August 2002 period are used in investigating the short-run and the long-run effects of real depreciation of the dollar. The results reveal evidence of the J-Curve effect only in six industries. However, the long-run favorable effect of real depreciation is supported in 22 industries

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I. Introduction

In testing the short-run and the long-run effects of devaluation on the trade balance, empirical studies could be classified into two groups. The first includes those that have used aggregate trade data (i.e., total imports and exports of a country). The list includes Bahmani-Oskooee (1985), Rosesweig and Koch (1988), Flemigham (1988), Karunaratne (1988), Mead (1988), Noland (1989), Gerlach (1989), Himarios (1985, 1989), Bahmani-Oskooee and Pourheydarian (1991), Bahmani-Oskooee and Malixi (1992), Mahdavi and Sohrabian (1993), Bahmani-Oskooee and Alse (1994), Demirden and Pastine (1995), Backus et al. (1998), and Gupta-Kapoor and Ramakrishnan (1999). Like many other areas in economics, these studies have provided mixed conclusions, some supporting and some rejecting the J-Curve phenomenon.[1]

Because of the mixed conclusions, more recent studies have relied upon disaggregated data to test the phenomenon. Rose and Yellen (1989) was the first study to bring out the shortcomings associated with models using aggregate data and introduced a simple model that employed bilateral trade data between the United States and her six major trading partners. Their empirical results not only did not support the J-Curve pattern, but also failed to support any long-run relation between the trade balance and real exchange rate at the bilateral level. Marwah and Klein (1996), Shirvani and Wilbratte (1997), Bahmani-Oskooee and Brooks (1999), and Bahmani-Oskooee and Goswami (2003) are other studies who have provided no strong support for the J-Curve phenomenon using bilateral trade data.

In order to shed additional light on the short-run as well as the long-run relation between the exchange rate and the trade balance, we disaggregate the trade data further by using import and export data at the industry level. Specifically, monthly import and export data from 66 industries in the U.S. (SITC Commodity Groupings) over the January 1991-August 2002 period are employed in a trade balance model to test the J-Curve as well as the long-run effects of real depreciation of the dollar. To this end, in Section II we outline the model and the method of estimation. In Section III we report the empirical results. Section IV presents the conclusions of our analysis.[2]

II. The Trade Balance Model

In formulating the trade balance model at the commodity level, we follow closely the models in the second category reviewed above and establish a direct link between a measure of the trade balance and domestic income, foreign income, and real exchange rate as in equation (1):

$$\text{Ln } TB_{i,t} = a + b \text{ Ln } Y_{U.S.,t} + c \text{ Ln } Y_{W,t} + d \text{ Ln } RE_t + \varepsilon_t \qquad (1)$$

where TB_i is a measure of the trade balance defined as the ratio of imports of a specific commodity to exports of that commodity in the U.S.; $Y_{U.S.}$ is a measure of United States income; Y_W is a measure of income in the rest of the world and RE is the real effective exchange rate of the dollar.[3] Following the literature, we expect an estimate of b to be positive and that of c negative. Furthermore, since RE is defined as the real effective exchange value of the dollar, if a decrease or real depreciation is to discourage imports and encourage exports an estimate of d is

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1 For a review article see Bahmani-Oskooee and Ratha (2004).

2 An alternative way of assessing the impact of currency depreciation on the trade balance is to investigate separately the impact of changes in the exchange rate on exports and imports. Indeed, using the data base in this paper Bahmani-Oskooee and Ardalani (2006) have done so. However, using this alternative method, one cannot judge the existence of the J-curve phenomenon, for it is a concept on the relation between the trade balance and the exchange rate changes.

3 Note that in the absence of information about the sources of imports and exports we have no choice in using world income and real effective exchange rate.

expected to be positive.

In order to test the J-Curve effect, we need to incorporate the short-run dynamics into equation (1). In doing so we follow Pesaran et al (2001) and specify (1) as an error-correction model as in equation (2):

$$\Delta LnTB_{i,t} = a + \sum_{k=1}^{n} b_k \Delta LnTB_{i,t-k} + \sum_{k=0}^{n} c_k \Delta LnY_{U.S.,t-k} + \sum_{k=0}^{n} d_k \Delta LnY_{W,t-k} + \sum_{k=0}^{n} e_k \Delta LnRE_{t-k}$$

$$+ \delta_1 LnTB_{i,t-1} + \delta_2 LnY_{U.S.,t-1} + \delta_3 LnY_{W,t-1} + \delta_4 LnRE_{t-1} + \mu_t \qquad (2)$$

In this set up Pesaran et al. (2001) demonstrate that testing for cointegration is reduced to testing whether δ_1-δ_4 are jointly significant. They recommend the F-test with new critical values that take into consideration the unit root properties of the variables. Thus, there is no need for unit root testing. The new critical values are tabulated by Pesaran et al. (2001).

Once cointegration is established, we employ a criterion in selecting the appropriate order of the VAR and estimate (2). The J-Curve is supported if the estimate of e is negative at lower lags and positive at higher lags. The long-run relation between the trade balance and the exchange rate is determined by the estimate of δ_4 normalized on δ_1.

III. Empirical Results

As indicated in the introduction, this is the first study that employs trade data at the industry level. Monthly imports and exports data from 66 industries in the U.S. (SITC Commodity Groupings) over January 1991-August 2002 are used to estimate equation (2).[4] We first carry out the F-test for cointegration and report the results of the F-test in Table 1. Note that as pointed out

4 For the list of 66 industries see Table 1. While industry trade data comes from Bureau of Census (Foreign trade division, all other data come from the IFS CD-ROM.

by Bahmani-Oskooee and Brooks (1999), since the results could be sensitive to the order of VAR, we carry the F-test by varying the order of VAR from the minimum of two lags to a maximum of ten lags.

Table 1 goes about here

As can be seen, the calculated F is greater than its critical value of 3.57 in most instances, supporting cointegration. For example, at two lags, cointegration fails to hold only in 11 out of 66 industries. Such finding contradicts Rose and Yellen (1989) who found no evidence in support of cointegration when they used bilateral trade data between U.S. and her six major trading partners. We consider these results preliminary at this stage and provide additional evidence in support of cointegration later. Now that four variables are cointegrated, we retain their lagged level in (2) and re-estimate the model again. However, this time we employ Akaike's Information Criterion (AIC) in selecting the optimum number of lags. The short-run results, not reported but available from the authors revealed no specific pattern, thus no support for the J-curve. The long-run coefficient estimates are reported in Table 2.

Table 2 goes here

Concentrating on the coefficient obtained for the real exchange rate (LnRE), it appears that it is expectedly positive and significant in 22 cases implying that at least at the commodity level, exchange rate is a significant determinant of the corresponding trade balance. For example, while in the trade balance pertaining to airplane parts or airplanes (items 3 & 4) the real exchange rate carries an insignificant coefficient, in the results for alcoholic beverages, cigarettes and clothing (items 4, 11 & 12) it carries significantly positive coefficient implying that in these later industries real depreciation of the dollar will reduce imports and stimulate exports. In sum, industries that will react favorably to real depreciation of the dollar are identified as ADP equipment, alcoholic beverages, aluminum, basket ware, chemicals, cigarettes, clothing, coal, copper, cork, corn, footwear, lighting, meat, plastic articles, rice, rubber tires, silver, textile yarn, toys (games), travel goods, and vegetables (fruits). As for the income variables, the U.S. income carries a positive and significant coefficient in 25 industries. However, the world income carries its expectedly negative and significant coefficient only in 13 industries.[5]

IV. Conclusion and Summary

With this paper we open the door for another group in the J-Curve literature. We propose to disaggregate the trade data by employing imports and exports at the commodity level. Through the data bank of the Bureau of Census we were able to identify 66 commodity groupings for which monthly data from January 1991 till August 2002 were available. Using error-correcting modeling technique, while we were unable to find strong support for the J-Curve phenomenon, the long-run effects of real depreciation of the dollar were favorable at least in 22 industries. These were ADP equipment, alcoholic beverages, aluminum, basketware, chemicals, cigarettes, clothing, coal, copper, cork, corn, footwear, lighting, meat, plastic articles, rice, rubber tires, silver, textile yarn, toys (games), travel goods, and vegetables (fruits).

5. To provide additional support for cointegration, following Pesaran et al (2001), we use estimates of δ_1-δ_4 and form a lagged error-correction term (EC_{t-1}). After replacing the lagged level of variables by EC_{t-1} we impose the optimum number of lags on each first differenced variable selected by AIC and estimate each model again. A negative and significant coefficient obtained for EC_{t-1} is indicative of cointegration. In almost all cases, the EC_{t-1} carried a negative and significant coefficient. These results are also available upon request.

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Table 1: The Results of F-Test for Cointegration .

Commodities	Calculaed F Statistic for Different Lag Length Imposed on the First-Differenced Variables				
	2 lags	4 lags	6 lags	8 lags	10 lags
1-ADP equip.;office machines	4.62	6.92	3.25	1.63	3.52
2-Airplane parts	2.35	2.79	2.31	2.22	1.79
3-Airplanes	4.69	4.01	3.64	2.03	2.16
4-Alcoholic bev.,distilled	7.46	9.82	7.93	5.56	3.93
5-Aluminum	4.56	3.40	2.75	4.33	4.33
6-Animal feeds	6.96	10.19	10.60	5.51	2.40
7-Artwork/antiques	11.07	6.17	5.18	7.01	5.84
8-Basketware, etc.	8.31	6.78	6.24	8.01	3.39
9-Cereal flour	10.48	12.27	13.51	7.72	3.89
10-Chemicals	3.89	4.82	3.47	1.73	3.78
11-Cigarettes	2.32	1.94	2.82	2.93	2.81
12-Clothing	10.27	4.80	8.77	3.28	7.04
13-Coal	2.72	2.35	2.51	4.32	3.06
14-Copper	7.79	6.13	6.01	6.06	4.10
15-Cork, wood, lumber	5.62	5.15	2.88	2.60	2.45
16-Corn	8.34	10.21	10.33	6.37	1.87
17-Crudefertilizers/minerals	9.29	6.39	5.01	3.19	2.36
18-Electrical machinery	2.83	3.20	2.77	1.43	1.66
19-Fish and preparations	19.12	7.72	3.44	9.90	2.66
20-Footwear	12.41	5.12	3.00	4.17	2.02
21-Furniture and bedding	2.48	2.55	2.36	1.72	2.23
22-Gem diamonds	2.38	1.95	1.99	1.49	1.37
23-General industrialmach	5.60	2.99	2.88	2.37	4.93
24-Glass	4.90	4.58	3.86	2.48	2.73
25-Glassware	4.92	7.68	2.96	3.38	4.98
26-Gold, nonmonetary	4.77	4.93	5.72	4.29	5.02
27-Hides and skins	4.05	1.88	1.40	1.63	0.71
28-Iron and steel mill prod	4.65	4.82	5.77	4.47	3.16
29-Lighting, plumbing	3.17	2.48	2.54	2.91	3.03
30-Liquified propane/butane	5.71	6.31	3.43	2.78	2.21
31-Live animals	7.34	9.67	6.46	3.07	1.57
32-Meat and preparations	7.59	4.14	3.38	2.48	2.97
33-Metal manufactures,n.e.s.	5.53	5.83	3.14	3.89	5.46
34- Metal ores; scrap	1.83	1.21	1.74	1.69	1.60
35- Metalworking machinery	5.22	4.81	3.46	3.28	3.55
36- Mineral fuels, other	3.24	3.20	1.93	2.11	3.83
37- Natural gas	4.85	2.97	3.16	3.39	2.56
38- Nickel	6.34	3.87	3.68	3.30	2.41
39- Oils/fats, vegetable	3.43	3.51	2.51	1.66	1.02
40- Optical goods	9.00	5.83	3.81	6.50	3.95

Table 1 continued.

Commodities	Calculaed F Statistic for Different Lag Length Imposed on the First-Differenced Variables				
	2 lags	4 lags	6 lags	8 lags	10 lags
41- Paper and paperboard	2.17	3.42	2.29	1.40	3.03
42-Petroleum preparations	10.52	6.34	4.97	3.85	1.69
43-Photographicequipment	5.88	6.48	7.33	3.48	3.24
44- Plastic articles, n.e.s.	4.86	4.20	4.33	3.00	1.48
45- Platinum	5.92	4.73	3.32	3.10	2.37
46- Pottery	8.51	5.41	3.82	3.64	0.56
47-Power generating mach.	5.45	5.39	5.34	3.70	5.26
48- Printed materials	5.60	5.06	3.88	2.21	1.68
49-Pulp and waste paper	6.29	6.35	5.00	5.52	2.59
50-Records/magneticmedia	3.99	5.55	2.92	1.66	2.60
51-Rice	7.61	4.05	3.14	2.45	3.18
52-Rubber articles, n.e.s.	3.94	3.30	2.26	2.33	3.12
53-Rubber tires and tubes	4.07	2.48	4.90	1.88	2.73
54-Scientific instruments	4.04	3.62	4.41	3.37	1.87
55-Ships, boats	7.87	7.26	4.43	3.77	2.48
56-Silver and bullion	5.20	4.16	1.75	1.14	1.11
57-Specialized ind. mach.	6.23	5.20	4.11	3.28	5.33
58-Textile yarn, fabric	10.59	7.18	4.46	4.24	5.85
59-Tobacco,unmanufactured	7.47	4.65	5.31	5.06	4.93
60-Toys/games/sporting goods	14.38	22.97	7.77	3.03	3.03
61-Travel goods	10.52	9.15	8.97	8.32	4.29
62-Vegetables and fruits	11.50	22.52	9.89	4.79	2.65
63-Vehicles	5.65	3.11	2.30	1.99	2.57
64-Watches/clock/parts	6.35	9.80	7.26	2.94	1.74
65- Wheat	6.48	4.52	4.99	5.07	3.12
66- Wood manufactures	5.62	7.93	5.38	3.67	3.66

Table 2 : Long-Run Coefficient Estimates.

Commodities	Constant	Ln $Y_{U.S.}$	Ln Y_W	Ln RE
1-ADP equip.;office machines	4.66 (0.97)	3.53 (3.06)	-5.85 (2.43)	1.38 (1.81)
2-Airplane parts	-9.39 (1.05)	-0.12 (0.06)	2.48 (0.64)	-.55 (0.50)
3-Airplanes	-18.78 (1.53)	1.60 (0.53)	1.13 (0.21)	1.00 (0.89)
4-Alcoholic bev.,distilled	-5.79 (2.75)	0.04 (0.08)	0.81 (0.92)	0.75 (3.95)
5-Aluminum	10.16 (1.70)	5.33 (3.57)	-9.17 (3.29)	1.67 (2.61)
6-Animal feeds	-1.88 (1.05)	2.46 (5.78)	-1.89 (2.44)	-0.61 (3.66)
7-Artwork/antiques	-0.76 (0.13)	3.51 (2.48)	-3.20 (1.29)	0.07 (0.14)
8-Basketware, etc.	-0.61 (0.36)	0.48 (1.20)	-0.82 (1.17)	0.54 (3.70)
9-Cereal flour	-11.03 (8.05)	0.50 (1.52)	2.05 (3.46)	-0.16 (1.06)
10-Chemicals	-4.78 (2.56)	1.36 (3.02)	-0.89 (1.10)	0.49 (2.30)
11-Cigarettes	-108.52 (1.36)	-16.10 (0.92)	29.11 (0.89)	9.68 (2.00)
12-Clothing	-14.26 (1.16)	0.72 (0.23)	-0.06 (-.01)	2.79 (2.56)
13-Coal	-13.38 (0.94)	4.21 (1.18)	-5.66 (0.93)	3.94 (2.91)
14-Copper	13.93 (3.27)	1.92 (1.81)	0.06 (0.03)	1.16 (2.77)
15-Cork, wood, lumber	-1.01 (0.31)	5.70 (7.11)	-6.17 (4.28)	0.70 (2.50)
16-Corn	-10.60 (1.06)	1.62 (0.68)	-2.31 (0.56)	1.93 (2.11)
17-Crude fertilizers/minerals	-0.76 (0.51)	1.12 (2.99)	-0.69 (1.00)	-0.32 (2.11)
18-Electrical machinery	3.71 (1.40)	-0.01 (0.01)	-0.10 (0.08)	-0.63 (2.13)
19-Fish and preparations	-4.82 (1.72)	2.52 (3.63)	-1.43 (1.18)	0.14 (0.61)
20-Footwear	-3.23 (1.15)	0.83 (1.16)	-0.74 (0.60)	1.21 (4.81)
21-Furniture and bedding	-9.21 (1.45)	1.74 (1.02)	-0.17 (0.06)	0.66 (1.10)
22-Gem diamonds	226.16 (2.03)	37.77 (1.88)	-76.47 (1.78)	-9.52 (2.33)
23-General industrial mach	2.80 (0.89)	2.20 (2.72)	-3.41 (2.22)	0.58 (1.53)
24-Glass	16.88 (1.07)	4.89 (1.39)	-8.56 (1.19)	-0.03 (0.04)
25-Glassware	10.39 (1.26)	3.46 (1.53)	-5.61 (1.39)	0.04 (0.09)
26-Gold, nonmonetary	-8.16 (0.51)	1.43 (0.36)	0.72 (0.10)	-0.55 (0.41)
27-Hides and skins	9.23 (0.61)	0.39 (0.11)	-2.18 (0.33)	-0.76 (0.56)
28-Iron and steel mill prod	15.08 (2.31)	3.30 (2.05)	-6.66 (2.32)	0.29 (0.45)
29- Lighting, plumbing	-18.92 (4.52)	1.66 (1.69)	0.56 (0.33)	1.98 (5.61)
30- Liquified propane/butane	20.30 (1.95)	4.18 (1.70)	-7.51 (1.75)	-0.77 (0.77)
31- Live animals	2.31 (0.23)	0.99 (0.41)	-1.02 (0.24)	-0.24 (0.23)
32- Meat and preparations	-6.83 (1.29)	-0.86 (0.69)	-1.24 (0.56)	3.36 (6.36)
33-Metal manufactures,n.e.s.	2.03 (1.45)	0.99 (2.95)	-1.91 (3.25)	0.52 (4.31)
34- Metal ores; scrap	4.84 (0.42)	-0.24 (0.09)	0.56 (0.11)	-1.36 (1.36)
35- Metalworking machinery	3.88 (0.95)	1.96 (1.96)	-2.17 (1.23)	-0.57 (1.63)
36- Mineral fuels, other	22.26 (1.42)	4.61 (1.16)	-10.02 (1.40)	0.46 (0.38)
37- Natural gas	4.88 (0.37)	5.12 (1.59)	-4.51 (0.80)	-1.05 (0.96)
38- Nickel	-8.69 (1.99)	-5.13 (4.91)	8.26 (4.53)	-0.97 (2.51)
39- Oils/fats, vegetable	-10.43 (.66)	-3.40 (0.94)	5.94 (0.90)	-0.22 (0.16)
40- Optical goods	10.74 (6.89)	-0.89 (2.41)	-0.85 (1.33)	-0.46 (3.07)

Table2 continued.

Commodities	Constant	LYUS	LYW	LRE
41- Paper and paperboard	-4.78 (0.94)	0.06 (0.06)	0.44 (0.21)	0.58 (1.36)
42-Petroleum preparations	-9.42 (1.52)	-0.15 (0.10)	2.42 (0.90)	0.04 (0.08)
43-Photographic equipment	1.81 (0.68)	1.39 (2.13)	-1.67 (1.45)	-0.04 (0.16)
44- Plastic articles, n.e.s.	4.03 (1.57)	0.27 (0.45)	-1.48 (1.38)	0.38 (1.69)
45- Platinum	1.03 (0.09)	0.92 (0.34)	1.50 (0.31)	-2.24 (2.19)
46- Pottery	-1.04 (0.26)	0.26 (0.27)	0.71 (0.41)	-0.15 (0.45)
47- Power generating mach.	-0.55 (0.28)	0.85 (1.73)	-0.89 (1.03)	0.14 (0.87)
48- Printed materials	-2.72 (0.38)	2.33 (1.25)	-2.23 (0.68)	0.38 (0.75)
49-Pulp and waste paper	0.25 (0.11)	1.22 (2.31)	-1.13 (1.21)	-0.24 (1.06)
50-Records/magnetic media	-4.22 (0.28)	5.31 (0.84)	-6.76 (0.72)	2.23 (1.54)
51-Rice	-15.63 (2.64)	0.38 (0.27)	1.40 (0.57)	1.17 (1.95)
52-Rubber articles, n.e.s.	10.80 (2.96)	0.67 (0.76)	-2.49 (1.58)	-0.41 (1.03)
53-Rubber tires and tubes	0.13 (0.03)	1.29 (1.00)	-2.99 (1.28)	1.76 (3.48)
54-Scientific instruments	1.78 (0.77)	2.39 (4.48)	-3.31 (3.24)	0.42 (1.95)
55-Ships, boats	3.62 (0.28)	6.52 (2.08)	-6.86 (1.25)	-0.56 (0.53)
56-Silver and bullion	-1.58 (0.09)	1.09 (0.24)	-3.41 (0.43)	2.73 (1.82)
57-Specialized ind. mach.	10.59 (3.94)	2.95 (4.64)	4.94 (4.37)	-0.37 (1.63)
58-Textile yarn, fabric	1.46 (1.41)	0.86 (3.74)	-1.49 (3.58)	0.37 (3.99)
59-Tobacco, unmanufactured	-11.21 (0.95)	-2.54 (0.87)	4.35 (0.85)	0.51 (0.52)
60-Toys/games/sporting goods	-11.20 (1.91)	0.05 (0.04)	0.96 (0.39)	1.70 (3.78)
61-Travel goods	0.65 (0.52)	-0.15 (0.52)	-0.07 (0.14)	0.62 (5.58)
62-Vegetables and fruits	-4.51 (1.29)	0.90 (1.01)	-0.47 (0.31)	0.55 (1.84)
63-Vehicles	0.68 (0.13)	1.28 (1.05)	-1.79 (0.84)	0.54 (1.24)
64-Watches/clock/parts	-0.12 (0.03)	-0.58 (0.63)	0.90 (0.53)	0.21 (0.65)
65- Wheat	12.92 (1.05)	8.67 (2.81)	-13.83 (2.43)	1.64 (1.34)
66- Wood manufactures	1.77 (0.37)	5.49 (4.90)	-6.28 (3.16)	0.60 (1.50)