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Mohsen Bahmani-Oskooee
Jia Xu

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THE S-CURVE DYNAMICS OF U.S.-MEXICO COMMODITY TRADE

Mohsen Bahmani-Oskooee*
University of Wisconsin-Milwaukee

Jia Xu
St. Mary's College of Maryland

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In testing the short-run effects of currency depreciation on the trade balance, rather than engaging in regression analysis, part of the literature basically looks at the correlation coefficients between past and future values of the trade balance and the current exchange rate. It is postulated that these coefficients are positive between future values of the trade balance and current exchange rate, but negative between past values of the trade balance and the current exchange rate, hence the S-Curve pattern. Previous research has shown that the curve is not supported for Mexico when aggregate trade data are used. In this paper we used bilateral trade data between Mexico and her main partner, the United States to test the curve. Still there was no support for the curve. However, when we disaggregated bilateral trade flows by industry and considered the trade balances of 223 industries that trade between the two countries, we were able to support the S-Curve in 90 industries.

JEL classification codes: F31

Key words: S-Curve, industry data, United States, Mexico

I. Introduction

The relation between the trade balance and the real exchange rate is one of many areas in international economics that has attracted a great deal of attention. Before the current floating exchange rate system that began in 1973, all researchers were

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* Mohsen Bahmani-Oskooee (corresponding author): The Center for Research on International Economics, The Department of Economics, University of Wisconsin-Milwaukee, bahmani@uwm.edu. Jia Xu: Department of Economics, St. Mary's College of Maryland, jxu@smcm.edu. Valuable comments of two anonymous referees are greatly appreciated. Any remaining errors, however, are ours.

concerned only with the long-run effects of devaluation on the trade balance by estimating and verifying the well-known Marshall-Lerner condition. It was in 1973 that Magee (1973) and Junz and Rhomberg (1973) conjectured that the short-run effects of a devaluation or depreciation on the trade balance could be different than its long-run effects, mostly due to adjustment lags. They argued that if a country's trade balance deteriorates, adhering to devaluation will not prevent the trade balance from deterioration in the short run. The trade balance will continue to deteriorate and improvement will come later, hence the "J-Curve" phenomenon. To test the phenomenon, Bahmani-Oskooee (1985) introduced a simple trade balance model that was used to demonstrate how one can test the phenomenon through regression analysis.[1]

An alternative method of testing the short-run relationship between the trade balance and the terms of trade or the real exchange rate was introduced in 1994 by Backus et al. (1994). Using general-equilibrium approach they demonstrated that cross-correlation coefficients between the current exchange rate and future values of the trade balance are positive. However, the cross-correlation coefficients between current exchange rate and past values of the trade balance are negative. Since the plot of the cross-correlation coefficients against the number of leads and lags used to construct the cross-correlation coefficients resembles the letter S, they label their finding the "S-Curve".[2]

Since this paper concentrates on the experience of Mexico, a brief review of the literature is in order. A few studies that have dealt with the trade flows of Mexico, have concentrated on the impact of the NAFTA. Using aggregate import and export data from 1983-2001, McDaniel and Agama (2003) estimated import and export demand models to show that NAFTA had a significant effect on aggregate trade flows. They also showed that changes in the peso-dollar exchange rate had significant impacts on the trade flows. Fullerton and Sprinkle (2005) is another study that estimated import and export demand models for Mexico using quarterly data from 1980-2002. Like any other standard model, they show that income and relative prices do play a significant role in the trade between Mexico and the U.S. Finally, Pacheco-López (2005) explored the effects of both Mexico's 1980s trade liberalization and NAFTA on U.S.-Mexico trade as well as the role of the real peso-dollar exchange rate. Her main conclusion is that indeed, while trade liberalization has had a greater effect on Mexican imports than Mexican exports,

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

[2] For the most recent review of S-Curve related papers see Bahmani-Oskooee and Hegerty (2010).

the exchange rate did not play a significant role in the trade balance between Mexico and the U.S. Could this insignificant relation between the bilateral trade balance between Mexico and the U.S. and the real peso-dollar exchange rate be due to aggregation bias?

In this paper we consider the trade balance between Mexico and the U.S. one more time. However, rather than engaging in regression analysis, we follow the route prescribed by Backus et al. (1994), i.e., the S-Curve. When the S-Curve was introduced by Backus et al., they empirically tested the curve using aggregate trade data between one country and the rest of the world for 11 OECD countries. No strong support was presented in the case of United States. Suspecting that aggregation bias, again, could play a role here, Bahmani-Oskooee and Ratha (2007a) disaggregated U.S. trade data by her trading partners and tested the S-Curve using bilateral trade balances between U.S. and each of her 24 partners. They produced evidence supporting the S-Curve between the U.S. and many of her trading partners.[3] Unfortunately, Mexico was not included among the partners. Senhadji (1998) tested the S-Curve for 30 developing countries, and Parikh and Shibata (2004) tested it for another set of 14 Asian, 25 African, 20 Latin American countries. They all used trade flows of each country with the rest of the world. No support for the S-Curve was found for Mexico which was one of the countries included in Parikh and Shibata (2004).

In this paper we test the S-Curve between U.S. and Mexico to determine if there is any S-Curve pattern at a bilateral level. As it will be shown, since the answer is not in the affirmative, we take an additional step and disaggregate the trade data between the two countries by industry and test the S-Curve for 223 industries that trade between the two countries.[4] We provide support for the S-Curve in 90 cases. The rest of the paper is organized in the following manner. Section II provides the definition of the variables and the method. Results are produced in Section III with a summary and conclusion in Section IV.

II. Data and methodology

In constructing the cross-correlation coefficients one must be careful in defining the variables. The two variables of concern, i.e., the trade balance and the real

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[3] Note that they considered 24 trading partners and produced the 24 S-Curves. In most cases, the S-curve received support.

[4] Analyzing industry level data is becoming a common practice in the trade literature. For example, see intra-industry trade in Latin America by Fullerton et al. (2011).

exchange rate must be defined in a manner that a positive correlation between the two variables implies an improvement in the trade balance due to a depreciation. Since exports and imports data are reported by the United States and in terms of the U.S. dollar, we define the variables from the U.S. perspective. Denoting U.S. exports of commodity *i* to Mexico by X_i and her imports of commodity *i* by M_i, following previous research we define the U.S. real trade balance of industry i by $\frac{(X_i - M_i)}{GDP_{US}}$ where GDP_{US} is U.S. Gross Domestic Product, all variables in nominal term. The real exchange rate between the two countries is defined as $\frac{P_{MEX}}{P_{US}.E}$ where P_{MEX} is the price level in Mexico; P_{US} is the price level in the United States, and E is the nominal exchange rate defined as number of pesos per U.S. dollar. In this set up, a real depreciation of the U.S. dollar is reflected by an increase in the real exchange rate. The data on price levels (measured by CPI for both countries), the peso-dollar exchange rate, and the U.S. GDP all come from the International Financial Statistics of the IMF. The industry level trade data come from World Bank's WITS system (The World Bank in turn receives the data from the United Nations COMTRADE data base). Both variables are de-trended using the Hodrick-Prescott filter first to avoid any spurious outcome.

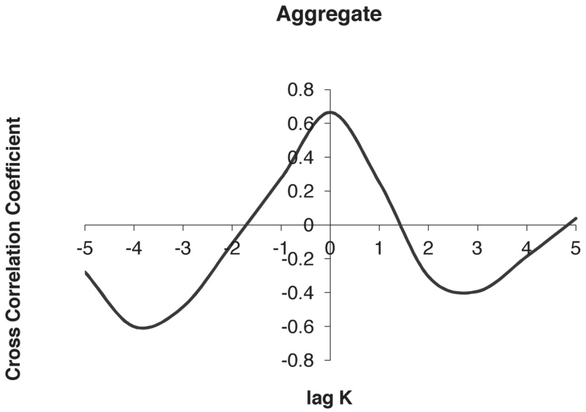
Given the above definition of both variables, a real depreciation of the dollar, i.e., an increase in the real exchange rate, is expected to improve the trade balance, yielding a positive correlation between the two variables. The S-Curve postulates that the cross-correlation coefficients are positive between the current value of the real exchange rate and the future values of the trade balance and negative between the past values of the trade balance and the current exchange rate. For ease of exposure we redefine the two variables as $(\frac{X_i - M_i}{GDP_{US}})_{t+k}$ and $(\frac{P_{MEX}}{P_{US}.E})_t$ and then calculate cross-correlation coefficients between the real exchange rate at time *t* and the net exports of each industry at time *t+k* by allowing *k* to be -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, and 5. We then produce the S-Curve by plotting the constructed correlation coefficients against *k*.[5]

[5] For a detailed explanation of constructing cross-correlation function using lags and leads see Bahmani-Oskooee and Ratha (2007b).

III. Results

As mentioned, as a first step, and following Bahmani-Oskooee and Ratha (2007a, 2007b) we wonder whether disaggregating the trade data at bilateral level and considering Mexico-U.S. trade, the S-Curve could receive any support. To this end, we use annual bilateral trade data over the period 1989-2008 and produce the S-Curve in Figure 1.

Figure 1. The bilateral S-Curve between Mexico and the United States



As can be seen, even at bilateral level, there is no support for the S-Curve. Moving beyond the literature, we now disaggregate U.S.-Mexico trade data by commodity and produce the S-Curves for 223 industries that trade between the two countries. The Revision 3 data set provided by the World Bank is the most comprehensive data set that includes the largest number of industries that trade among countries. It provides annual data on trade flows of all industries over the period 1989-2008. Obviously, reporting 223 S-Curve graphs requires a large journal space. To economize journal space, we first summarize our findings for all industries in Table 1 by reporting each industry's name, its SITC code, and each industry's average trade share during most recent years (2000-2008)[6], and cross-correlation coefficients for lag 2, lag 0, and lead 2. The last column of the table indicates whether the S-Curve is supported for a given industry using cross-correlation coefficients for all five lags and five leads.[7]

[6] Trade share of each industry is defined as sum of imports and exports of that industry as a percent of sum of imports and exports by all industries.

[7] A table is available from the corresponding author showing cross-correlation coefficients for all lags and leads.

Table 1. Industries studied with average trade shares (2000-2008) and cross-correlation coefficients

Code	Product name	Average trade share	Cross-correlation coefficient			Support
			Lag 2	Lag 0	Lead 2	
001	Live animals except fish	0.24	0.20	0.15	-0.57	
011	Beef, fresh/chilld/frozn	0.28	0.42	0.57	-0.50	
012	Meat nes,fresh/chld/froz	0.31	-0.08	0.46	-0.24	
034	Fish,live/frsh/chld/froz	0.04	-0.56	0.58	0.33	Yes
035	Fish,dried/salted/smoked	0.00	-0.37	0.23	0.24	Yes
036	Crustaceans molluscs etc	0.17	0.04	0.65	0.06	Yes
037	Fish/shellfish,prep/pres	0.03	-0.67	-0.30	0.49	Yes
044	Maize except sweet corn.	0.40	0.01	-0.51	0.24	
046	Flour/meal wheat/meslin	0.01	0.24	-0.03	-0.27	Yes
047	Cereal meal/flour n.e.s	0.02	-0.24	0.22	0.11	
048	Cereal etc flour/starch	0.29	-0.35	0.36	0.21	Yes
054	Vegetables,frsh/chld/frz	1.12	0.12	0.67	-0.26	
056	Veg root/tuber prep/pres	0.14	-0.03	0.26	-0.36	
057	Fruit/nuts, fresh/dried	0.64	-0.48	0.30	0.30	Yes
058	Fruit presvd/fruit preps	0.11	-0.22	0.48	0.14	Yes
059	Fruit/veg juices	0.05	-0.26	0.59	0.11	Yes
061	Sugar/mollasses/honey	0.13	0.37	-0.14	-0.15	Yes
062	Sugar confectionery	0.12	-0.05	0.68	0.04	
071	Coffee/coffee substitute	0.11	-0.11	0.78	0.22	Yes
072	Cocoa	0.01	0.21	0.30	0.16	
073	Chocolate/cocoa preps	0.10	0.10	0.44	-0.07	
075	Spices	0.016	-0.63	0.23	0.41	Yes
081	Animal feed ex unml cer.	0.22	-0.11	0.49	0.07	Yes
098	Edible products n.e.s.	0.34	-0.15	0.39	0.04	Yes
111	Beverage non-alcohol nes	0.11	-0.60	0.55	0.29	Yes
112	Alcoholic beverages	0.79	-0.40	-0.12	0.22	Yes
121	Tobacco, raw and wastes	0.01	-0.08	0.11	0.48	Yes
122	Tobacco, manufactured	0.01	-0.71	0.12	0.65	Yes
211	Hide/skin (ex fur) raw	0.05	0.50	0.34	-0.80	
222	Oil seeds etc - soft oil	0.46	-0.18	-0.13	-0.14	Yes
223	Oil seeds-not soft oil	0.03	-0.17	0.00	-0.20	
231	Natural rubber/latex/etc	0.005	0.06	-0.69	0.09	Yes

Table 1. (continued) Industries studied with average trade shares (2000-2008) and cross-correlation coefficients

Code	Product name	Average trade share	Cross-correlation coefficient			Support
			Lag 2	Lag 0	Lead 2	
232	Rubber synth/waste/etc	0.11	0.20	-0.34	-0.43	Yes
245	Fuel wood/wood charcoal	0.00	-0.32	0.47	0.45	Yes
246	Wood chips/waste	0.00	0.17	-0.58	0.01	Yes
247	Wood in rough/squared	0.01	0.30	0.37	-0.42	
248	Wood simply worked	0.13	0.18	0.68	0.02	
251	Pulp and waste paper	0.24	-0.05	-0.51	0.29	Yes
263	Cotton	0.19	0.01	0.02	-0.43	
265	Veg text fibre ex cot/ju	0.00	0.27	-0.37	0.14	Yes
266	Synthetic spinning fibre	0.07	0.35	0.38	-0.47	Yes
267	Man-made fibres nes/wast	0.01	0.38	-0.17	-0.52	
268	Wool/animal hair	0.01	0.21	-0.74	-0.19	Yes
269	Worn clothing etc	0.015	-0.59	0.45	-0.07	
273	Stone/sand/gravel	0.05	0.47	0.05	-0.49	
274	Sulphur/unroastd pyrites	0.02	-0.83	0.23	0.32	Yes
277	Natural abrasives n.e.s.	0.00	-0.21	0.49	0.21	Yes
278	Other crude minerals	0.06	0.34	0.52	-0.62	
282	Ferrous waste/scrap	0.12	-0.15	-0.40	-0.11	Yes
283	Copper ores/concentrates	0.05	-0.26	0.14	-0.15	
287	Base metal ore/conc nes	0.06	0.07	0.15	-0.03	
288	Nf base metal waste nes	0.14	0.29	0.56	-0.30	
289	Precious metal ore/conc.	0.03	0.22	0.50	-0.16	
291	Crude animal mterial nes	0.13	-0.20	0.35	0.33	Yes
292	Crude veg materials nes	0.14	-0.09	0.08	0.08	
334	Heavy petrol/bitum oils	2.43	0.51	0.12	-0.46	
335	Residual petrol. prods	0.13	0.18	-0.05	-0.11	
411	Animal oil/fat	0.09	-0.16	-0.45	0.08	Yes
421	Fixed veg oil/fat, soft	0.08	-0.04	-0.35	-0.12	
422	Fixed veg oils not soft	0.01	0.05	-0.47	-0.03	Yes
431	Animal/veg oils proces"d	0.03	-0.41	-0.11	0.40	Yes
511	Hydrocarbons/derivatives	0.59	0.04	-0.33	0.07	Yes
512	Alcohols/phenols/derivs	0.16	-0.03	0.07	-0.19	Yes
513	Carboxylic acid compound	0.26	-0.33	-0.02	0.15	Yes
514	Nitrogen function compds	0.14	0.18	-0.22	-0.34	Yes

Table 1. (continued) Industries studied with average trade shares (2000-2008) and cross-correlation coefficients

Code	Product name	Average trade share	Cross-correlation coefficient			Support
			Lag 2	Lag 0	Lead 2	
515	Organo-inorganic compnds	0.10	-0.05	0.28	-0.20	
516	Other organic compounds	0.24	0.05	-0.04	-0.43	
522	Elements/oxides/hal salt	0.14	0.42	0.12	-0.43	
523	Metal salts of inorg acd	0.14	-0.09	0.08	-0.18	
524	Other inorganic chemical	0.06	0.09	0.08	-0.18	
531	Synth org colour agents	0.05	0.21	-0.28	-0.49	
532	Dyeing/tanning extracts	0.00	-0.36	-0.04	0.72	Yes
533	Pigments/paints/varnish	0.26	0.00	0.48	-0.36	
541	Pharmaceut exc medicamnt	0.13	-0.45	0.43	0.15	Yes
542	Medicaments include vet	0.24	0.31	0.20	-0.37	
551	Essent.oil/perfume/flavr	0.07	-0.33	0.52	-0.11	
553	Perfume/toilet/cosmetics	0.18	-0.28	0.72	0.19	Yes
554	Soaps/cleansers/polishes	0.18	-0.36	0.26	0.34	Yes
571	Primary ethylene polymer	0.41	0.03	-0.19	-0.46	
572	Styrene primary polymers	0.24	0.26	-0.43	-0.42	
573	Vinyl chloride etc polym	0.07	0.22	-0.02	-0.44	
574	Polyacetals/polyesters..	0.37	0.35	0.36	-0.57	
575	Plastic nes-primary form	0.65	0.47	-0.04	-0.77	
579	Plastic waste/scrap	0.03	0.28	0.30	-0.11	
581	Plastic tube/pipe/hose	0.20	0.01	0.38	-0.35	
582	Plastic sheets/film/etc	0.59	-0.11	0.23	-0.33	
583	Monofilament rods/sticks	0.01	0.29	-0.56	-0.44	Yes
591	Household/garden chemcal	0.08	-0.45	-0.01	0.49	Yes
592	Starches/glues/etc.	0.11	0.09	0.29	-0.53	
593	Explosives/pyrotechnics	0.07	0.09	0.00	0.25	Yes
597	Oil etc additives/fluids	0.08	0.24	0.55	-0.59	
598	Misc chemical prods nes	0.38	0.02	-0.35	-0.29	
611	Leather	0.15	0.09	-0.11	0.02	
612	Leather manufactures	0.05	0.19	0.17	-0.24	Yes
613	Furskins tanned/dressed	0.00	0.06	0.25	0.02	
621	Materials of rubber	0.17	0.02	-0.20	0.10	Yes
625	Rubber tyres/treads	0.35	0.37	0.24	-0.84	

Table 1. (continued) Industries studied with average trade shares (2000-2008) and cross-correlation coefficients

Code	Product name	Average trade share	Cross-correlation coefficient			Support
			Lag 2	Lag 0	Lead 2	
629	Articles of rubber nes	0.28	0.30	0.15	-0.70	
633	Cork manufactures	0.00	-0.07	-0.46	0.55	Yes
634	Veneer/plywood/etc	0.09	-0.14	0.95	-0.03	
635	Wood manufactures n.e.s.	0.11	-0.19	0.49	0.29	Yes
641	Paper/paperboard	0.59	-0.03	0.08	-0.41	
642	Cut paper/board/articles	0.67	-0.14	0.30	0.01	
651	Textile yarn	0.30	0.40	-0.01	-0.64	
652	Cotton fabrics, woven	0.28	0.23	0.43	0.16	
653	Man-made woven fabrics	0.30	0.20	0.44	-0.04	
654	Woven textile fabric nes	0.04	-0.18	-0.63	0.22	Yes
655	Knit/crochet fabrics	0.23	0.16	0.21	0.05	
656	Tulle/lace/embr/trim etc	0.11	0.46	0.06	-0.47	
657	Special yarns/fabrics	0.47	0.15	0.49	0.12	
658	Made-up textile articles	0.35	-0.30	-0.03	-0.07	
659	Floor coverings etc.	0.05	-0.09	0.80	-0.08	
661	Lime/cement/constr mat"l	0.12	-0.17	0.36	0.10	Yes
662	Clay/refractory material	0.12	0.03	0.12	0.45	Yes
663	Mineral manufactures nes	0.22	0.49	0.15	-0.35	
664	Glass	0.41	-0.16	0.57	0.10	
665	Glassware	0.16	-0.76	-0.02	0.48	Yes
666	Pottery	0.02	-0.38	-0.04	0.52	Yes
667	Pearls/precious stones	0.05	0.09	-0.03	0.21	Yes
671	Pig iron etc ferro alloy	0.03	-0.28	0.13	0.50	Yes
672	Primary/prods iron/steel	0.31	0.25	0.55	-0.25	
673	Flat rolled iron/st prod	0.25	0.36	0.16	-0.02	
674	Rolled plated m-steel	0.22	-0.11	0.74	0.00	
675	Flat rolled alloy steel	0.22	0.71	0.03	-0.38	
676	Iron/steel bars/rods/etc	0.22	0.03	0.73	-0.29	
677	Iron/steel railway matl	0.01	0.25	-0.17	-0.69	
678	Iron/steel wire	0.06	0.11	0.26	-0.37	
679	Iron/steel pipe/tube/etc	0.31	0.00	0.42	-0.11	
681	Silver/platinum etc	0.27	-0.15	0.38	0.16	Yes

Table 1. (continued) Industries studied with average trade shares (2000-2008) and cross-correlation coefficients

Code	Product name	Average trade share	Cross-correlation coefficient			Support
			Lag 2	Lag 0	Lead 2	
682	Copper	0.58	-0.15	0.37	0.02	
684	Aluminium	0.49	0.09	-0.04	-0.43	
685	Lead	0.03	0.36	0.18	-0.20	
686	Zinc	0.10	0.22	0.20	0.04	
687	Tin	0.01	0.11	-0.08	-0.23	
689	Misc non-ferr base metal	0.02	0.39	0.13	-0.18	
691	Iron/stl/alum structures	0.17	-0.30	0.16	-0.03	Yes
692	Metal store/transpt cont	0.09	-0.15	0.41	-0.21	
693	Wire prod exc ins electr	0.12	0.00	0.58	-0.18	
694	Nails/screws/nuts/bolts	0.23	-0.25	-0.49	0.33	Yes
695	Hand/machine tools	0.18	0.41	0.28	-0.55	
696	Cutlery	0.06	-0.19	-0.28	0.05	Yes
697	Base metal h"hold equipms	0.20	0.61	0.06	-0.33	
699	Base metal manufac nes	1.98	0.12	0.15	-0.15	
711	Steam generating boilers	0.02	0.15	0.07	0.07	
713	Internal combust engines	2.48	0.11	0.72	-0.22	
714	Engines non-electric nes	0.37	0.25	0.22	-0.60	
716	Rotating electr plant	1.34	-0.46	0.36	0.01	Yes
718	Power generating equ nes	0.04	-0.27	-0.09	0.19	Yes
721	Agric machine ex tractr	0.13	0.09	0.65	-0.23	
722	Tractors	0.04	0.20	0.67	-0.37	
723	Civil engineering plant	0.52	0.03	0.69	-0.02	
724	Textile/leather machinry	0.09	0.41	-0.14	-0.62	
725	Paper industry machinery	0.02	0.38	-0.31	-0.28	
726	Printing industry machny	0.03	0.62	0.46	-0.64	
727	Food processing machines	0.03	0.34	0.56	-0.47	
728	Special indust machn nes	0.48	0.46	-0.03	-0.57	
731	Mach-tools remove mtrial	0.06	0.41	0.25	-0.44	
733	Mtl m-tools w/o mtl-rmvl	0.05	0.65	0.04	-0.61	
735	Metal machine tool parts	0.07	0.32	0.29	-0.53	
737	Metalworking machine nes	0.09	0.19	0.18	-0.23	
741	Indust heat/cool equipmt	1.11	0.21	0.68	-0.56	

Table 1. (continued) Industries studied with average trade shares (2000-2008) and cross-correlation coefficients

Code	Product name	Average trade share	Cross-correlation coefficient			Support
			Lag 2	Lag 0	Lead 2	
742	Pumps for liquids	0.38	0.25	0.36	-0.44	
743	Fans/filters/gas pumps	1.17	0.40	0.46	-0.61	
744	Mechanical handling equi	0.43	0.05	0.54	-0.46	
745	Non-electr machines nes	0.39	-0.11	0.09	0.12	Yes
746	Ball/roller bearings	0.08	0.57	0.26	-0.65	
747	Taps/cocks/valves	0.84	-0.47	-0.22	0.69	Yes
748	Mech transmission equmnt	0.29	0.37	0.30	-0.66	
749	Non-elec parts/acc machn	0.20	0.12	0.08	-0.47	
751	Office machines	0.10	0.22	0.16	-0.53	
752	Computer equipment	3.48	-0.35	-0.18	0.13	Yes
759	Office equip parts/accs.	1.31	-0.39	0.04	0.22	Yes
761	Television receivers	3.99	-0.02	0.22	0.25	
762	Radio broadcast receiver	0.75	-0.14	0.13	-0.08	Yes
763	Sound/tv recorders etc	0.17	-0.07	-0.38	0.36	Yes
764	Telecomms equipment nes	4.95	-0.24	-0.02	-0.21	Yes
771	Elect power transm equip	1.06	-0.47	0.23	0.66	Yes
772	Electric circuit equipmt	3.60	0.46	-0.40	-0.57	
773	Electrical distrib equip	3.39	-0.18	0.39	0.06	
774	Medical etc el diag equi	0.22	0.04	0.28	-0.49	
775	Domestic equipment	1.10	-0.01	-0.01	0.08	Yes
776	Valves/transistors/etc	2.20	0.38	-0.09	-0.41	
778	Electrical equipment nes	2.80	-0.05	0.34	-0.30	
781	Passenger cars etc	7.08	-0.26	0.06	0.18	Yes
782	Goods/service vehicles	3.47	-0.06	0.17	-0.18	
784	Motor veh parts/access	5.79	0.15	0.55	-0.34	
785	Motorcycles/cycles/etc	0.05	-0.17	0.30	0.35	Yes
786	Trailers/caravans/etc	0.20	-0.01	0.51	0.14	
791	Railway vehicles/equipmt	0.20	-0.17	-0.08	0.13	Yes
792	Aircraft/spacecraft/etc	0.36	0.24	0.42	-0.33	
793	Ships/boats/etc	0.06	0.22	0.29	-0.10	
811	Prefabricated buildings	0.03	-0.28	0.51	0.12	Yes
812	Sanitary/plumb/heat fixt	0.13	-0.31	0.35	0.19	Yes

Table 1. (continued) Industries studied with average trade shares (2000-2008) and cross-correlation coefficients

Code	Product name	Average trade share	Cross-correlation coefficient			Support
			Lag 2	Lag 0	Lead 2	
813	Lighting fixtures etc	0.42	-0.33	-0.10	0.12	Yes
821	Furniture/stuff furnishg	2.08	-0.25	0.17	-0.18	
831	Trunks and cases	0.05	-0.24	0.41	0.45	Yes
841	Mens/boys wear, woven	0.96	-0.48	0.00	0.22	Yes
842	Women/girl clothing wven	0.65	-0.49	-0.11	0.38	Yes
843	Men/boy wear knit/croch	0.14	-0.59	-0.09	0.44	Yes
844	Women/girl wear knit/cro	0.26	-0.47	0.19	0.38	Yes
845	Articles of apparel nes	1.27	-0.48	-0.03	-0.29	
846	Clothing accessories	0.22	-0.07	-0.52	-0.13	
848	Headgear/non-text clothg	0.06	-0.05	0.12	-0.04	
851	Footwear	0.16	-0.31	0.52	0.58	Yes
871	Optical instruments nes	0.05	-0.12	0.24	0.09	Yes
872	Medical/etc instruments	1.22	0.19	0.52	-0.40	
873	Meters and counters nes	0.45	0.36	0.47	-0.56	
874	Measure/control app nes	1.53	-0.26	0.42	-0.11	Yes
881	Photographic equipment	0.15	-0.31	-0.16	-0.02	Yes
882	Photographic supplies	0.29	-0.19	0.12	-0.01	Yes
883	Cine fild developed	0.00	0.54	-0.05	-0.40	
884	Optical fibres	0.12	-0.11	0.23	0.30	Yes
885	Watches and clocks	0.05	-0.10	-0.07	0.09	
891	Arms and ammunition	0.01	-0.52	0.47	0.22	Yes
892	Printed matter	0.34	-0.24	0.67	0.14	Yes
893	Articles nes of plastics	1.71	0.21	0.40	-0.14	
894	Baby carr/toy/game/sport	0.44	0.21	0.25	-0.24	
895	Office/stationery supply	0.15	0.38	0.04	-0.77	
896	Art/collections/antiques	0.02	-0.17	0.10	-0.07	
897	Jewellery	0.22	0.09	0.42	0.25	
898	Musical instrums/records	0.34	0.36	0.73	-0.29	
899	Misc manuf articles nes	0.31	-0.25	0.66	-0.02	
971	Gold non-monetary ex ore	0.24	0.25	0.58	-0.13	

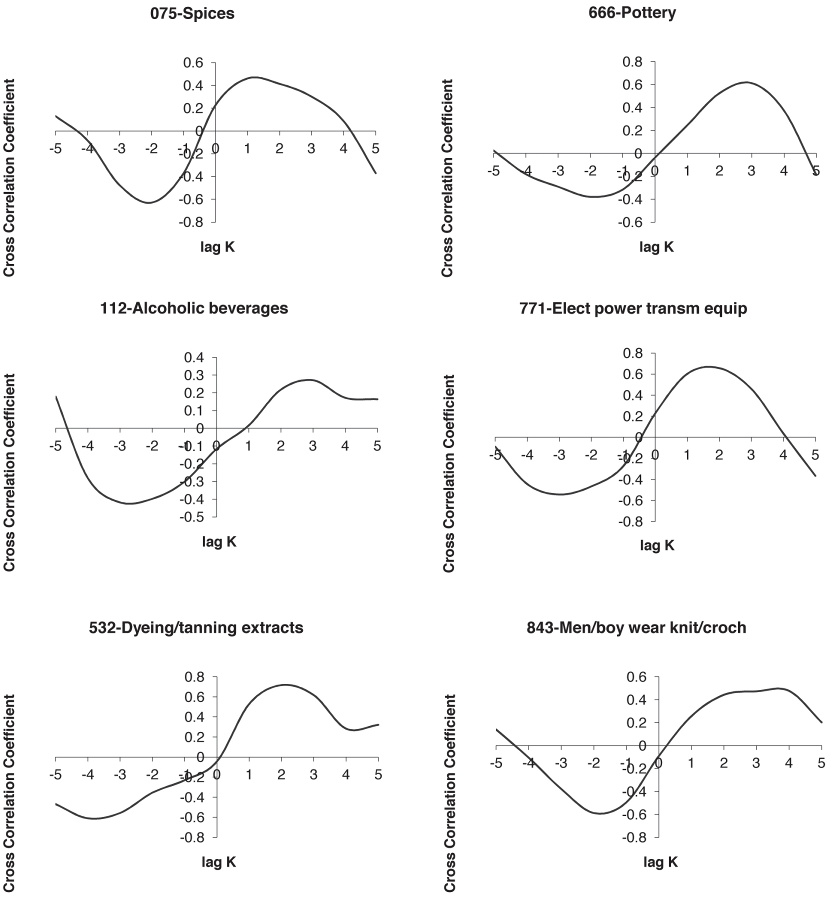
The evidence from Table 1 clearly shows that the S-Curve is validated in 90 out of 223 industries. This inference is based on the plot of cross-correlation coefficients for all five lags and five leads. Therefore, it appears that indeed, lack of support for the S-Curve in Figure 1 is clearly due to aggregation bias. Note that the list of industries for which the S-Curve is supported includes small (e.g., industries coded 034, 037, etc.) and large industries (e.g., 752, 781, etc.). The same is true of durables and non-durable commodities. Thus, commodity attributes do not seem to play a major role. Thus, it appears that peso depreciation will benefit the trade balance of these 90 industries in the future since cross-correlation coefficients between the current exchange rate and future trade balances are positive. The remaining 133 industries that do not seem to benefit from peso depreciation could be those for which demand elasticities could be low. These could also be industries with large shares of intra-industry trade or production-sharing with major trading partners as pointed out by Bahmani-Oskooee and Hegerty (2009). Indeed, our findings using cross-correlation method seems to be consistent with Bahmani-Oskooee and Hegerty (2009) who used the same data set and bounds testing approach to cointegration and error-correction modeling to conclude that almost 75% of the industries do not respond to exchange rate changes.[8]

For demonstrative purpose, we plot the cross-correlation coefficients at different lags and leads for six selected industries and produce six S-Curves at commodity level in Figure 2.[9]

[8] During our study period Mexican peso has experienced a few modifications such as the 1976, 1982, 1986, and 1994 devaluations and later on a move from fixed to flexible rate. Mexico itself has entered into a couple of trade agreements such as GATT and NAFTA. Usually, structural breaks are captured by including dummy variables if the method is based on regression analysis as in Bahmani-Oskooee and Hegerty (2009). Since the method here is based on cross correlation coefficient between the trade balance and the real exchange rate, no dummy could be incorporated into the analysis. This does not seem to be too serious of a problem because our findings are close to those of Bahmani-Oskooee and Hegerty (2009) who used regression analysis and included dummy variables.

[9] Again to save space and for brevity we only report the S-Curves for six industries but make available these curves for all 90 industries upon request from the corresponding author.

Figure 2. The S-Curve for six selected industries



IV. Summary and conclusion

An alternative method of depicting the short-run relationship between a country's trade balance and her exchange rate is through the so called "S-Curve". It asserts that while the cross-correlation coefficients between the current value of the exchange rate and future values of the trade balance are positive, the same cross-correlations between the current exchange rate and past values of the trade balance are negative.

Just like the literature on the J-Curve, in testing the S-Curve early studies used aggregate trade data between one country and the rest of the world and provided support for some countries in their sample. Using aggregate trade data, these early studies have examined the curve for more than 100 countries. In countries that the S-Curve did not receive support, aggregation bias is said to play a key role. Thus, a second set of studies have used trade data at bilateral level and produced better results.

Considering the experience of Mexico and the U.S., aggregate data have not supported the S-Curve pattern for neither country. In this paper, we first used bilateral data for the two countries with no success in producing the S-Curve. Suspecting that the bilateral S-Curve could still suffer from aggregation bias, we disaggregated the trade flows between the U.S. and Mexico by commodity and considered the experiences of 223 industries that trade between the two countries. We were able to discover the S-Curve pattern for 90 industries only. The findings could imply that real depreciation of the peso against the dollar will befit these 90 industries in the future.

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