JOURNAL OF ECONOMIC DEVELOPMENT 1
Volume 37, Number 1, March 2012

EXCHANGE-RATE VOLATILITY AND INDUSTRY TRADE BETWEEN THE U.S. AND KOREA

MOHSEN BAHMANI-OSKOOEE[a], HANAFIAH HARVEY[b] AND SCOTT W. HEGERTY[c*]

[a]*University of Wisconsin-Milwaukee, U.S.A.*
[b]*Penn State University, U.S.A.*
[c]*Canisius College, U.S.A.*

Even though numerous empirical studies have investigated the effects of the post-Bretton Woods increase in exchange-rate volatility, they have not reached a consensus whether this uncertainty universally reduces trade flows. As a result, recent studies have employed industry-level data to further isolate the causes of these ambiguous results. In this study, we investigate U.S. trade with South Korea, both at the bilateral level and for 96 U.S. export and 29 U.S. import industries. We find that exchange rate volatility has significant short-run effects on most industries' exports and imports. In the long run, however, only 16 exporting industries and seven importing industries are affected by volatility (some positively and some negatively). Most affected industries are small, as measured by their trade share.

Keywords: Exchange Rate Volatility, Industry Data, Korea, the United States
JEL classification: F31

1. INTRODUCTION

In the nearly 40 years since the breakdown of Bretton Woods, exchange rates between industrial nations have fluctuated greatly. The effects of this volatility -particularly on the volume of trade flows- have been intensively studied in the literature. But as empirical techniques have become more sophisticated, and as more finely disaggregated data have become available for more countries, this area of study has been extended into new directions. In this study, we continue this process and investigate the effects of won-dollar exchange-rate volatility on industry-level trade between South Korea and the United States. Our results shed new insight into this important trade partnership, particularly in light of the recent literature.

This body of literature, while extensive, often shows that volatility can have positive

[*] The valuable comments of an anonymous referee are greatly appreciated. Any error, however, is ours.

or negative effects on trade flows. McKenzie (1999) provides an excellent review of the literature up to the new millennium. Bahmani-Oskooee and Hegerty (2007) highlight the fact that not only is there no universally agreed-upon measure of exchange-rate variability in the literature (although a few proxies are most commonly used), there is no theoretical justification for this volatility to *increase*, *decrease*, or *have no impact on* countries' trade flows. This contradicts what is most commonly assumed, that exchange-rate risk, like any risk, tends to reduce trade flows. The authors cite numerous empirical studies in their review, and find that these, too, register mixed results.

In studies that explicitly focus on Korean trade flows -most often as part of a multi-country study- volatility has generally been shown to reduce trade flows. Examples include Bahmani-Oskooee (1996), Doroodian (1999), Arize *et al.* (2000, 2003), Doğanlar (2002), and Poon *et al.* (2005). Not every study agrees, however; some (such as Bahmani-Oskooee, 1996) show negative effects on Korea but positive effects on other countries, while others show a non-negative result for Korea. Bahmani-Oskooee and Payesteh (1993) find inconsistent results over the period from 1973 to 1990. Giorgioni and Thompson (2002), specifically examining U.S. wheat exports to a panel of countries, find that *import* volatility, not *exchange-rate* volatility, plays a key role in reducing exports. It is also important to note that these studies differ in their choices of proxy for exchange-rate variability. Some of the more common measures include ARMA residuals (Doroodian, 1999), GARCH processes, and a moving standard deviation of the exchange rate (Doğanlar, 2002). For annual data (such as will be used in this study), it is also possible to use the within-period standard deviation, based on 12 monthly observations within each year (Bahmani-Oskooee and Hegerty, 2009a).[1]

More recently, additional studies have provided insight into Korea's trade flows and into bilateral industry trade flows for other country pairs. Baak *et al.* (2007) examines Korea's exports both to Japan and to the U.S., using quarterly data over the period from 1981 to 2004. Applying the Johansen (1990) cointegration method and measuring exchange-rate volatility as a moving standard deviation, the authors find that this variability tends to reduce Korean trade flows. Ozturk and Kolyancu (2009) apply the Engle-Granger (1987) two-step cointegration methodology to quarterly Korean data from 1980 to 2005. Here, too, the authors find significantly negative effects for Korea, but the coefficients are positive for other countries in their multi- country sample.

These newer studies could be extended in two ways. First, they could make use of newer time-series methods. Secondly, and more importantly, they could use industry, rather than bilateral data. Studies such as Bahmani-Oskooee and Hegerty (2009a), applied to this type of trade between the United States and Mexico, and Bahmani-Oskooee and Hegerty (2009b), with respect to U.S.-Japan trade, do just that. Furthermore, they

[1] For some other studies that use aggregate data see Weliwita and Tsujii (2000) and Jin *et al.* (2006). Other studies concentrate on trade as well as domestic output, e.g., Mehanna and Shamsub (2002) and Domac (1997).

find that individual industries provide idiosyncratic results, which are often obscured when less finely disaggregated data are used.

We thus extend this method of analysis to a study of industry-level trade between the United States and South Korea. Applying the Autoregressive Distributed Lag (ARDL) method, which provides a cointegration test and short-and long-run coefficient estimates in a single step, we examine annual trade flows from 1965 to 2006 for bilateral import and export flows, as well as for 96 individual export and 29 individual import industries. We find that exchange-rate volatility has a *positive* impact on both bilateral import and export flows. The industry-level effects are more mixed, with most industries registering no effect at all.

This paper proceeds as follows. Section 2 outlines our empirical methodology. Section 3 provides the empirical results. Section 4 concludes and our data are explained in the Appendix.

2. METHODOLOGY

In our analysis, we use the most common reduced-form model for trade flows, which model each flow (in real terms) as a function of the purchasing country's income, the relative price of exports or imports relative to competing substitutes, and a measure of real-exchange-rate volatility. The income variable is Korean real GDP for U.S. exports, and U.S. real GDP for its imports from Korea. Following Kenen and Rodrik (1986), or Bahmani-Oskooee and Hegerty (2009a, b), we use the PPI-based won-dollar real exchange rate for the relative price. An increase in the real exchange rate represents a depreciation of the won or an appreciation of the dollar. Finally, following Akhtar and Hilton (1984), or Bahmani-Oskoeee and Hegerty (2009a), we use the within-period standard deviation (using the 12 monthly real exchange-rate variable within each year) for our volatility term.

Our long-run model, which we put in log-linear form and to which we add a dummy to account for the 1997 Asian Crisis, is thus as follows:

$$VX_{it} = f\left(Y_{it}^{Korea}, REX_{it}, VOL_{it}\right), \tag{1}$$

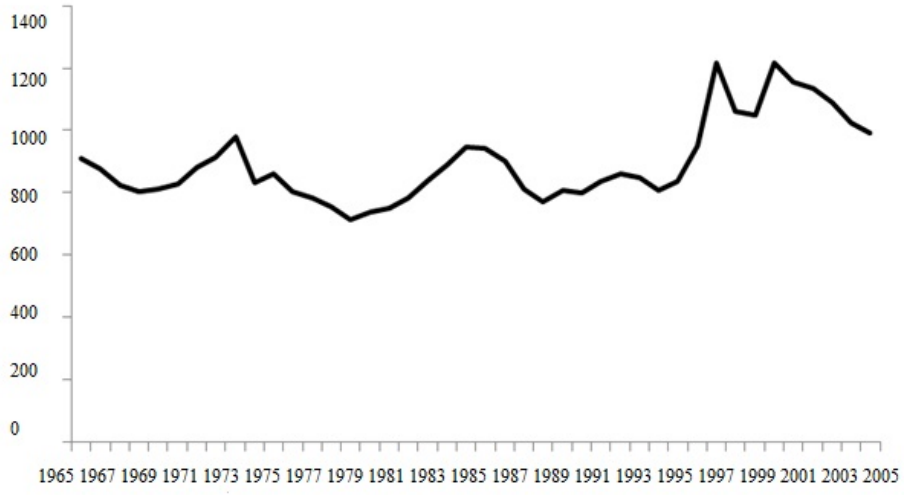
$$VM_{it} = f\left(Y_{it}^{US}, REX_{it}, VOL_{it}\right), \tag{2}$$

for each industry i at time t. It is important to note the trade flows are modeled as volumes, or dollar values divided by prices as explained in detail in the Appendix. Since data are reported by the U.S., we outline the models from the U.S. perspective. Hence, in (1) VX_{it} is U.S. exports for industry i to Korea and in (2), VM_{it} is U.S. imports for industry i from Korea. We expect the income coefficient to be uniformly positive and the *REX* coefficient (for which a decrease represents a depreciation of the dollar) to be

negative in Equation (1) and positive in Equation (2). The sign of the volatility coefficient could be negative or positive, if it is significant.

Next, we discuss our econometric methodology. Since many of our variables, particularly real income and the trade flows of certain growing industries, might be nonstationary, we apply a procedure that is able to incorporate both I(0) and I(1) variables. Figures 1 and 2 show the time-series plots of the real exchange rate and its volatility, respectively. Formal unit-root tests, available from the authors, confirm what might be surmised visually: that *REX* is nonstationary (integrated of order 1), while *VOL* is stationary.

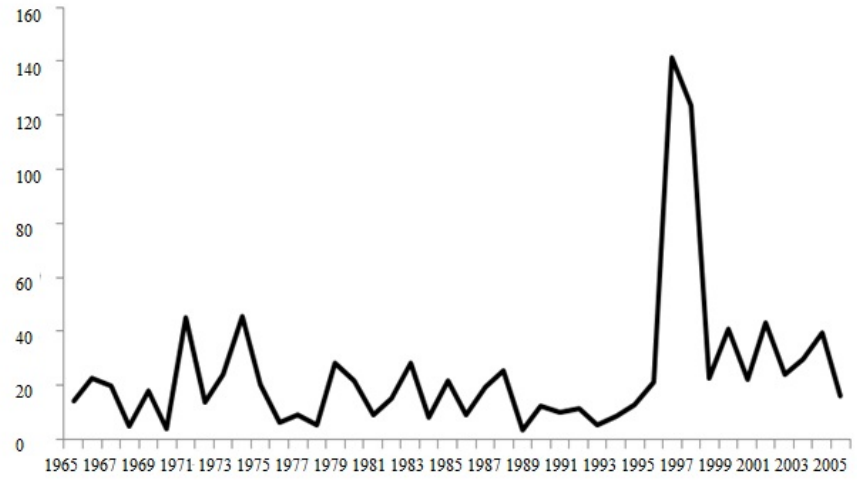
Our choice of methodology, Pesaran *et al.*'s (2001) bounds testing or ARDL approach, is able to use both types of variable.[2] In addition, it has two other highly desirable properties. First, it has been shown to work well in small samples (see Bahmani-Oskooee and Hegerty, 2009b). Secondly, it provides short-run estimates, long-run estimates, and a cointegration test within a single Ordinary Least Squares estimate.



Source: The International Financial Statistics of the International Monetary Fund.

Figure 1. Won-Dollar PPI-Based Real Exchange Rate, 1965-2006

[2] For other applications of this approach see Halicioglu (2007), Narayan *et al.* (2007), Tang (2007), Mohammadi *et al.* (2008), Wong and Tang (2008), and Bahmani-Oskooee and Gelan (2009).



Note: Within-period standard deviation of the 12 monthly real exchange-rate observations within each year.
Source: The International Financial Statistics of the International Monetary Fund.

Figure 2. Volatility of the Won-Dollar PPI-Based Real Exchange Rate, 1965-2006

Our ARDL models are as follows:

$$\Delta \ln VX_t = \alpha_0 + \alpha_1 D97 + \sum_{j=1}^{n1} \beta_j \Delta \ln VX_{t-j} + \sum_{j=0}^{n2} \gamma_j \Delta \ln Y_{t-j}^{Korea} + \sum_{j=0}^{n3} \delta_j \Delta \ln REX_{t-j} + \sum_{j=0}^{n4} \kappa_j \Delta \ln VOL_{t-j} + \theta_1 \ln VX_{t-1} + \theta_2 \ln Y_{t-1}^{Korea} + \theta_3 \ln REX_{t-1} + \theta_4 \ln VOL_{t-1} + \varepsilon_t, \quad (3)$$

and

$$\Delta \ln VM_t = \alpha_2 + \alpha_3 D97 + \sum_{j=1}^{n5} \phi_j \Delta \ln VM_{t-j} + \sum_{j=0}^{n6} \varphi_j \Delta \ln Y_{t-j}^{U.S.} + \sum_{j=0}^{n7} \pi_j \Delta \ln REX_{t-j} + \sum_{j=0}^{n8} \vartheta_j \Delta \ln VOL_{t-j} + \theta_5 \ln VX_{t-1} + \theta_6 \ln Y_{t-1}^{U.S.} + \theta_7 \ln REX_{t-1} + \theta_8 \ln VOL_{t-1} + \varepsilon_t, \quad (4)$$

This error-correction format is similar to that of Engle and Granger (1987), except that it includes the lagged level (forcing) variables individually rather than as a group. These models are estimated by Ordinary Least Squares. From the estimates, while

short-run effects are judged by the coefficient estimates of first-differenced variables, the long-run effects are inferred by the estimates of θ_2 through θ_4 on θ_1 in (3) and θ_6 through θ_8 on θ_5 in (4). Of course, the long-run coefficients will only be valid if cointegration among the variables in each model is established. Pesaran *et al.* (2001) demonstrate and apply an F-test for joint significance of lagged level variables as a sign of cointegration. In an equilibrium state, where deviations are zero, only the level variables should remain. If the level variables are indeed jointly significant, we can say that there is a long-run relationship among them. The new critical values that account for integrating properties of the variables are provided by Pesaran *et al.* (2001) for large samples and by Narayan (2005) for small samples like ours.

Because this "bounds test" only provides unambiguous results if the F-statistics are sufficiently high (supporting cointegration) or sufficiently low (showing no cointegration), we must use an alternative test for those industries that lie below the upper bound. This is done by grouping the fitted values of our "cointegrating vector" into a single error-correction term, labeled ECM_{t-1}. Replacing this term into Equation (3) or (4) where appropriate for each industry allows us to estimate whether its coefficient is significantly negative. If it is, we can say that the variables together work to "cancel out" any movement in the trade flow and thus have a significant joint relationship. We discuss these relationships below.

3. RESULTS

We next apply our methodology to a set of individual trade flows, both at the bilateral level and for SITC 3-digit industries. Our data are annual, over the period from 1965 to 2006, and comprise total trade as well as 96 U.S. export industries to Korea and 29 U.S. import industries from Korea. Industry names, SITC codes, and relative sizes are given below in Tables 2 and 3.

First, we impose a maximum of four lags on each first-differenced variable and use the Akaike Information Criterion (AIC) to select the optimum number of lags. We then perform our cointegration tests at these lags. The small-sample critical values, per Narayan (2005), are 2.933 for the lower bound and 4.020 for the upper bound.[3] Our cointegration tests results (both F test as well as ECM test) are given in Table 1. We find that for U.S. exports, 70 out of 96 individual industries show evidence of cointegration by at least either the F test or ECM test. As for U.S. imports, there is evidence of cointegration by at least one of the criteria in 17 cases.

[3] Note that lower bound critical values are calculated by assuming all variables in a model are I(0), and upper bound critical values are calculated by assuming all variables to be I(1).

Table 1. Cointegration Test Results

U.S. Exports to Korea				***U.S. Imports From Korea***			
CODE	F-test	ECM_{t-1}	Cointegrated?	Code	F-test	ECM_{t-1}	Cointegrated?
TTX	3.25	-0.24 (3.12)	Yes	TTM	3.97	-0.09 (3.99)	Yes
13	9.00	-0.64 (2.85)	Yes	31	3.88	-0.03 (0.34)	No
22	1.16	-0.40 (4.07)	Yes	32	3.81	-0.08 (1.64)	No
24	2.56	-0.31 (2.14)	Yes	55	6.16	-0.20 (3.25)	Yes
41	1.92	-0.12 (1.16)	No	276	6.13	-0.26 (1.70)	Yes
44	1.28	-0.53 (3.29)	Yes	291	4.93	-0.45 (2.93)	Yes
48	4.21	-0.66 (4.04)	Yes	292	1.69	-0.14 (1.25)	No
53	4.62	-0.84 (4.94)	Yes	512	1.00	-0.01 (0.12)	No
54	0.44	-1.24 (5.91)	Yes	631	2.67	-0.41 (3.68)	Yes
55	4.22	-0.85 (4.36)	Yes	632	3.79	-0.41 (6.01)	Yes
61	2.83	-0.58 (3.49)	Yes	641	3.11	-0.13 (1.58)	No
62	1.40	-0.54 (4.25)	Yes	652	0.67	0.16 (1.46)	No
73	0.89	-0.28 (2.57)	Yes	653	2.08	0.01 (0.19)	No
81	3.36	-0.20 (0.70)	No	656	5.93	0.09 (1.07)	Yes
91	2.14	-0.50 (3.42)	Yes	664	6.11	0.01 (0.13)	Yes
99	2.20	-0.33 (2.96)	Yes	666	2.61	-0.06 (1.13)	No
112	2.45	-0.49 (2.90)	Yes	698	5.95	-0.05 (1.06)	Yes
211	3.36	-0.01 (0.14)	No	724	2.39	-0.11 (2.61)	Yes
231	1.31	-0.31 (2.19)	Yes	729	4.04	-0.31 (4.49)	Yes
242	2.09	0.17 (1.24)	No	812	1.89	0.21 (2.86)	No
243	2.79	-0.16 (1.15)	No	821	5.00	-0.13 (3.35)	Yes
251	0.85	-0.07 (0.64)	No	831	4.94	-0.15 (4.13)	Yes
263	2.22	-0.06 (0.51)	No	841	2.67	-0.08 (1.75)	No
266	1.95	-0.37 (3.17)	Yes	851	6.26	0.03 (1.06)	Yes
267	2.07	-0.40 (3.09)	Yes	891	6.77	-0.12 (3.46)	Yes
273	1.01	-0.39 (3.64)	Yes	892	1.85	0.16 (2.63)	No
275	1.58	-0.14 (1.34)	No	894	4.40	-0.08 (2.98)	Yes
282	2.38	-0.95 (5.47)	Yes	896	2.14	-0.18 (1.87)	No
291	1.54	-0.15 (1.88)	No	897	4.24	-0.04 (1.39)	Yes
332	2.54	-0.12 (1.30)	No	899	0.95	-0.39 (3.68)	Yes
411	6.09	-0.27 (2.49)	Yes				
512	1.40	-0.09 (1.26)	No				
513	0.87	-0.13 (1.27)	No				
514	3.66	-0.36 (3.38)	Yes				
515	4.68	-1.17 (5.38)	Yes				
531	4.28	-0.27 (2.33)	Yes				
541	5.89	-0.10 (1.05)	Yes				
551	1.91	-0.16 (0.75)	No				
553	1.55	-0.46 (4.19)	Yes				
554	1.78	-0.37 (3.62)	Yes				
581	1.51	-0.35 (3.23)	Yes				
599	1.20	-0.13 (1.11)	No				

629	1.02	-0.34 (2.89)	Yes	
641	1.04	-0.26 (2.91)	Yes	
642	3.87	-0.18 (2.36)	Yes	
651	3.52	-0.94 (5.79)	Yes	
653	1.99	-0.33 (2.63)	Yes	
655	1.34	-0.38 (2.55)	Yes	
656	3.12	-0.64 (3.22)	Yes	
661	2.60	-0.16 (0.89)	No	
662	2.64	-0.22 (0.96)	No	
663	1.35	-0.44 (3.12)	Yes	
664	0.98	-0.14 (1.51)	No	
665	1.94	-1.06 (4.24)	Yes	
673	5.03	-0.69 (4.71)	Yes	
674	1.04	-0.17 (0.83)	No	
677	2.25	-0.20 (1.20)	No	
678	3.48	-0.41 (2.74)	Yes	
679	3.02	-0.93 (3.93)	Yes	
682	7.36	-0.82 (5.69)	Yes	
684	3.57	-0.48 (4.06)	Yes	
691	3.03	-0.45 (3.30)	Yes	
692	6.80	-1.00 (5.37)	Yes	
693	1.47	-0.19 (1.14)	No	
694	1.18	-0.23 (1.91)	No	
695	3.70	-0.77 (4.45)	Yes	
697	2.45	-0.03 (0.16)	No	
698	2.47	-0.39 (3.29)	Yes	
711	1.77	-0.73 (6.59)	Yes	
712	5.36	-1.08 (8.33)	Yes	
714	2.67	-0.12 (1.45)	No	
715	1.56	-0.68 (4.04)	Yes	
717	1.56	-1.12 (4.27)	Yes	
718	1.89	-0.10 (0.80)	No	
719	2.99	-0.35 (2.74)	Yes	
722	1.21	-0.58 (2.62)	Yes	
723	3.04	-0.37 (2.31)	Yes	
724	2.47	-0.37 (4.08)	Yes	
725	3.62	-0.74 (3.61)	Yes	
726	4.02	-0.16 (1.36)	Yes	
729	2.24	-0.28 (3.53)	Yes	
731	6.44	-1.47 (9.82)	Yes	
732	5.36	-1.13 (6.43)	Yes	
733	4.78	-1.21 (6.15)	Yes	
812	1.58	-0.22 (2.01)	Yes	
821	4.95	-0.31 (2.62)	Yes	
841	3.89	-0.65 (4.65)	Yes	
861	3.57	-0.49 (4.64)	Yes	

862	4.17	-0.34 (2.92)	Yes	
863	0.49	-0.17 (1.59)	No	
864	2.97	-0.39 (2.91)	Yes	
891	2.30	-0.77 (5.08)	Yes	
892	2.69	-0.32 (2.79)	Yes	
893	0.73	-0.25 (1.96)	Yes	
894	2.19	-0.46 (2.82)	Yes	
895	3.21	-0.69 (4.75)	Yes	
899	1.72	0.02 (0.11)	No	

Note: The lower bound critical value for the F-statistic with unrestricted intercept and no trend at the 10% level of significance is 2.933. The upper bound critical value is 4.020. This comes from Narayan (2005). The number inside the parenthesis next to estimated coefficient is the absolute value of the t-ratio. We use critical values of 1.64 at the 10% significance level and 1.96 at the 5% significance level.

Next, we move to the analysis of short-run coefficient estimates for all industries and the long-run estimates for cointegrated industries. We first examine the Export model estimations, which are given in Table 2.

The main focus of our investigation is the role of exchange-rate volatility. In the interests of space, we omit the other explanatory variables' short-run coefficients (as well as the intercept and 1997 dummy) from our tables. Most industries - 59 of 96, plus total exports, have significant short-run coefficients reflected by the coefficient estimates of $\Delta \ln VOL_{t-i}$ variables. In 59 industries, there is at least one short-run coefficient that is significant at least at the 10 percent level, implying that most industries' exports are affected by exchange rate uncertainty in the short run. Do these short-run effects last into the long run?

From the long-run results, we gather that the effects of exchange rate volatility are not as pronounced. Only in 16 cases does exchange rate volatility carry a significant coefficient. While 12 industries, as well as total exports, respond positively, four industries respond negatively (as classified in Table 2). These industries are all fairly small. Those with positive coefficients include industries Stone, stand, gravel, coded 273 (with 0.02% trade share, which is reported next to the name of each industry)[4]; Iron and steel scrap, coded 282 (0.62%); Radioactive and associated material, coded 515 (0.43%); Soaps, cleaning and polishing, coded 554 (0.23%), Textile fabrics, coded 653 (0.04%); Glassware, coded 665 (0.22%); Aluminum, coded 684 (0.27%); Power generating machinery, coded 711 (2.36%); Domestic electrical equipment, coded 725 (0.10%); Railway vehicles, coded 731 (0.06%); Photographic and cinematographic supplies, coded 862 (0.13%); Office and stationery supplies, coded 895 (0.03%). Those that see their trade reduced include Mineral manufacturers, coded 663 (0.23%); Textile yarn and

[4] Each industry's trade share is defined as its exports as a percent of total exports from U.S. to Korea. The same applies for import's share.

thread, coded 651 (0.12%); Clothing except fur clothing, coded 841 (0.17%) and Vegetables, coded 054 (0.13%). In the remaining 44 cointegrated industries, cointegration must be due to significance of either the Korean income or the real exchange rate itself as classified, again, in Table 2. Thus, it appears that Korean economic activity is the most important determinant of U.S. exports to Korea in the long run.

For U.S. imports from Korea, we shift to Table 3. Again, we classify the 29 industries by the long-run effects of exchange rate volatility, i.e., those that are positively affected, negatively affected, not affected but cointegrated, and not affected and not cointegrated. Once again, cointegration is established at least by one of the two criteria. From the short-run coefficient estimates we see that there are 15 industries in which there is at least one significant short-run coefficient (again, at the 10% level), implying that almost half of the industries in the sample are affected by exchange rate volatility in the short run. We ask again whether these short-run effects translate into the long run? From the long-run estimates we gather that exchange rate volatility carries a significant coefficient in seven industries. Furthermore, while in five industries (coded 632, 724, 729, 831, and 899) the effect is positive, in two industries, coded 291 and 891, it is negative. Note that this time, the two largest industries, i.e., Telecommunication apparatus, coded 724 (with 14.79% of the import share) and Other electrical machinery, coded 729 (with 8.19% of the import share) are affected positively by exchange rate volatility. Perhaps these two industries are contributing to the significant long-run effects of exchange rate volatility on U.S. total imports from Korea.

These results are able to tell us something important regarding the differences between bilateral (total trade) and industry results. Our finding of significantly positive relationship between exchange rate volatility and bilateral trade flows between U.S. and Korea is in line with the findings of Bahmani-Oskooee and Payesteh (1993), who used aggregate export and import data from several developing countries, including Korea. They also found that exchange rate volatility has significantly positive effects on Korean exports and imports. Our findings are also in line with Klein (1990, p. 29) who found similar results and argued that "exchange rate volatility may promote trade due to its effect on the expected profits of risk-neutral firms."

This theoretical justification for a positive relation between exchange rate volatility and trade flows is therefore supported by our bilateral U.S.-Korean data. For example, Viaene and de Vries (1989) argue that because importers and exporters are on opposite sides of a risky trading relationship, their respective roles are reversed, leading to a positive coefficient on a volatility variable for one partner. Sercu (1992) and Sercu and Vanhulle (1992) show that by increasing the probability that the price a trader receives might exceed trade costs, exchange rate volatility could stimulate trade. Finally, Broll and Eckwert (1999) conclude that volatility increases the value of a trader's option to export; since this risk increases the potential gains from trade, the volume of trade will increase accordingly.

Table 2. Short- and Long-Run Coefficient Estimates for Export Model (3)

Short-Run Coefficient Estimates

Code	Name	Share rank	$\Delta \ln VOL_t$	$\Delta \ln VOL_{t-1}$	$\Delta \ln VOL_{t-2}$	$\Delta \ln VOL_{t-3}$
TTX	Total exports		0.09 (3.16)	0.09 (3.55)		
Positively affected by exchange-rate volatility in the Long Run						
273	Stone, sand and gravel (0.02)	90	-0.13 (0.99)	-0.43 (2.08)	-0.31 (2.33)	
282	Iron and steel scrap (0.62)	20	-0.03 (0.35)	-0.24 (2.10)	-0.12 (1.64)	
515	Radioactive and associated material (0.43)	28	0.25 (0.55)	-1.08 (2.69)		
554	Soaps,cleansing & polishing prepara (0.23)	38	0.03 (0.56)	-0.55 (3.67)	-0.52 (4.63)	-0.27 (3.63)
653	Text fabrics woven ex narrow, spec (0.04)	79	0.06 (0.36)	-0.31 (1.83)		
665	Glassware (0.22)	42	0.20 (2.03)			
684	Aluminium (0.27)	35	0.06 (0.44)	-0.28 (1.73)		
711	Power generating machinery, other t (2.36)	6	0.06 (1.05)	-0.50 (3.36)	-0.59 (5.46)	-0.35 (5.16)
725	Domestic electrical equipment (0.10)	58	0.29 (2.66)			
731	Railway vehicles (0.06)	69	0.60 (3.01)	-0.86 (1.55)	-0.81 (1.81)	-0.67 (2.61)
862	Photographic and cinematographic su (0.13)	52	0.09 (1.11)	-0.36 (4.04)		
895	Office and stationery supplies, nes (0.03)	80	0.15 (1.23)			
Negatively affected by exchange-rate volatility in the Long Run						
054	Vegetables, roots & tubers, fresh o (0.13)	53	-0.03 (0.21)	0.58 (2.13)	0.27 (1.54)	
663	Mineral manufactures, nes (0.23)	40	-0.23 (2.06)			
651	Textile yarn and thread (0.12)	56	-0.04 (0.28)	0.58 (2.28)	0.57 (3.00)	0.21 (1.63)
841	Clothing except fur clothing (0.17)	45	-0.07 (0.55)			
Not affected by exchange-rate volatility in the Long Run but Cointegrated						
013	Meat in airtight containers nes & m (0.05)	74	0.13 (0.70)	-0.66 (1.67)	-0.53 (2.36)	
022	Milk and cream (0.08)	64	0.68 (2.66)	0.89 (3.09)		
024	Cheese and curd (0.07)	66	0.01 (0.11)			
044	Maize-corn–unmilled (2.35)	7	-0.00 (0.03)	0.48 (1.24)	0.57 (2.52)	
048	Cereal preps & preps of flour of fr (0.10)	59	-0.07 (0.39)			
053	Fruit,preserved and fruit preparati (0.16)	48	-0.11 (1.60)			
055	Vegetables, roots & tubers pres or (0.06)	71	0.13 (0.94)	-0.31 (1.16)	-0.45 (2.19)	-0.31 (2.22)
061	Sugar and honey (0.05)	77	-0.06 (0.32)			

062	Sugar confy, sugar preps. ex chocol (0.03)	83	-0.12 (0.72)	0.43 (1.22)	0.79 (2.96)	0.57 (3.43)
073	Chocolate & other food preptns cont (0.13)	54	-0.13 (0.96)	0.04 (0.22)	0.29 (2.27)	
091	Margarine & shortening (0.005)	94	0.07 (0.33)			
099	Food preparations, nes (0.03)	84	-0.01 (0.02)			
112	Alcoholic beverages (0.13)	55	-0.00 (0.21)	0.16 (1.34)		
231	Crude rubber-incl.synthetic & recla (0.25)	36	0.13 (0.90)			
266	Synthetic and regenerated-artificia (0.06)	72	-0.10 (0.83)			
267	Waste materials from textile fabric (0.004)	95	-0.15 (0.85)			
411	Animal oils and fats (0.06)	70	-0.05 (0.64)	0.52 (2.07)	0.61 (2.99)	0.19 (1.62)
514	Other inorganic chemicals (0.35)	31	0.05 (0.83)			
531	Synth.organic dyestuffs, natural ind (0.03)	82	-0.07 (0.97)	0.03 (0.30)	-0.12 (1.68)	
541	Medicinal & pharmaceutical products (0.86)	19	0.17 (3.52)	-0.35 (3.43)	-0.35 (4.08)	-0.17 (2.95)
581	Plastic materials,regenerd.cellulos (2.77)	5	0.05 (0.61)			
629	Articles of rubber, nes (0.08)	65	-0.03 (0.25)			
641	Paper and paperboard (0.55)	24	0.02 (0.33)			
642	Articles of paper, pulp, paperboard (0.05)	76	0.04 (0.49)			
653	Perfumery, cosmetics, dentifrices (0.52)	25	-0.27 (2.03)	-0.17 (1.77)	-0.18 (2.69)	
656	Made-up articles,wholly or chiefly (0.01)	93	0.16 (0.78)			
673	Iron and steel bars,rods,angles,sha (0.05)	75	-0.04 (0.24)	-0.26 (1.80)		
678	Tubes,pipes and fittings of iron or (0.20)	43	-0.14 (1.12)	-0.18 (1.02)	-0.32 (2.87)	
679	Iron steel castings forgings unwork (0.03)	81	-0.09 (0.49)	-0.00 (0.00)	-0.40 (2.01)	
682	Copper (0.17)	46	0.19 (1.09)			
691	Finished structural parts and struc (0.08)	63	-0.07 (0.49)	0.24 (1.53)		
692	Metal containers for storage and tr (0.09)	62	-0.18 (1.03)			
695	Tools for use in the hand or in mac (0.09)	61	-0.07 (0.89)	-0.42 (2.30)	-0.31 (2.33)	-0.14 (1.81)
698	Manufactures of metal, nes (0.24)	37	-0.00 (0.08)	0.08 (0.72)	-0.05 (0.71)	-0.11 (2.13)
712	Agricultural machinery and implement (0.16)	49	0.07 (0.76)			
715	Metalworking machinery (2.32)	8	0.16 (1.27)	0.49 (2.00)	0.37 (2.49)	
717	Textile and leather machinery (0.06)	73	0.03 (0.26)	-0.32 (1.08)	-0.18 (0.76)	-0.29 (2.19)
719	Machinery and appliances-non electr (9.09)	2	-0.02 (0.49)			
722	Electric power machinery and switch (1.77)	11	-0.08 (1.05)			
723	Equipment for distributing electric (0.18)	44	0.01 (0.09)			

724	Telecommunications apparatus (1.77)	12	-0.53 (0.01)	-0.32 (2.46)	-0.17 (2.30)	
726	Elec.apparatus for medic.purp., radi (0.59)	23	-0.01 (0.11)			
729	Other electrical machinery and appa (17.91)	1	0.10 (3.18)	0.12 (1.13)	0.18 (2.50)	0.10 (2.43)
732	Road motor vehicles (1.98)	10	0.10 (1.96)			
733	Road vehicles other than motor vehi (0.15)	50	-0.11 (0.82)			
812	Sanitary, plumbing heating & lightin (0.07)	68	-0.01 (0.14)	-0.24 (2.17)	-0.16 (2.35)	
821	Furniture (0.17)	47	-0.06 (0.63)	0.00 (0.01)	-0.24 (1.56)	-0.17 (1.67)
861	Scientific,medical,optical,meas./co (5.53)	3	-0.08 (1.78)			
864	Watches and clocks (0.02)	89	0.04 (0.29)			
891	Musical instruments,sound recorders (0.89)	17	0.04 (0.51)	-0.12 (1.21)		
892	Printed matter (0.37)	30	0.03 (0.53)			
893	Articles of artificial plastic mate (0.32)	34	0.11 (1.29)	-0.24 (2.60)		
894	Perambulators, toys, games and sporti (0.39)	29	-0.11 (0.72)	-0.33 (1.36)	-0.37 (2.27)	
Not affected by exchange-rate volatility in the Long Run and not Cointegrated						
041	Wheat- including spelt- and mesli (0.61)	21	-0.02 (0.61)	0.26 (3.02)	0.19 (3.86)	
081	Feed.-stuff for animals excl.unmill (0.60)	22	0.35 (1.33)	1.12 (2.98)	0.54 (2.15)	
211	Hides & skins,-exc.fur skins- under (1.04)	15	-0.01 (0.15)	-0.15 (2.72)		
242	Wood in the rough or roughly square (0.34)	32	0.22 (2.20)			
243	Wood, shaped or simply worked (0.07)	67	0.04 (0.36)	-0.48 (1.58)	-0.54 (2.36)	-0.33 (2.41)
251	Pulp & waste paper (0.89)	16	0.04 (0.63)	-0.53 (3.38)	-0.32 (2.84)	0.23 (3.37)
263	Cotton (0.33)	33	-0.16 (0.22)	-0.14 (1.59)		
275	Natural abrasives-incl.industrial d (0.02)	91	0.25 (1.48)			
291	Crude animal materials, nes (0.03)	85	-0.09 (0.71)	-0.50 (2.32)	-0.32 (2.28)	
332	Petroleum products (1.15)	14	-0.23 (1.76)	-0.25 (1.75)		
512	Organic chemicals (5.30)	4	-0.00 (0.02)			
513	Inorg.chemicals-elems., oxides, halog (0.87)	18	0.13 (1.49)	0.37 (2.19)	0.35 (3.43)	
551	Essential oils, perfume and flavor (0.05)	78	0.21 (1.79)			
599	Chemical materials and products, nes (1.70)	13	0.03 (0.65)			
655	Special textile fabrics and related (0.15)	51	0.04 (0.53)			
661	Lime,cement & fabr.bldg.mat.-ex gla (0.03)	86	-0.05 (0.37)	-1.95 (4.85)	-1.31 (4.42)	-0.45 (2.63)
662	Clay and refractory construction ma (0.23)	39	-0.17 (1.55)	-0.59 (3.60)	-0.21 (2.09)	
664	Glass (0.22)	41	0.03 (0.38)	-0.29 (2.85)	-0.18 (2.72)	

674	Universals,plates and sheets of iro (0.11)	57	0.44 (1.81)	0.16 (0.31)	-0.04 (0.10)	-0.40 (1.58)
677	Iron and steel wire, excluding wire (0.02)	92	-0.01 (0.08)	-0.11 (0.41)	-0.43 (2.19)	
693	Wire products – ex electric - & fen (0.03)	87	-0.01 (0.09)	-0.85 (2.71)	-0.87 (3.71)	-0.45 (2.92)
694	Nails, screws, nuts, bolts, rivets (0.10)	60	-0.20 (1.61)			
697	Household equipment of base metals (0.03)	88	0.21 (1.05)	-1.07 (2.69)	-0.90 (3.17)	-0.57 (3.12)
714	Office machines (2.02)	9	0.12 (2.26)			
718	Machines for special industries (0.46)	27	0.16 (2.18)			
863	Developed cinematographic film (0.004)	96	-0.21 (2.23)	-0.30 (3.06)		
899	Manufactured articles, nes (0.50)	26	0.05 (0.48)	-0.25 (2.25)		

Long-Run Coefficient Estimates

Code	Name	Share rank	lnY^{Korea}	ln*REX*	ln*VOL*
TTX	Total exports		1.02 (7.92)	-5.09 (3.29)	1.03 (2.79)
Positively affected by exchange-rate volatility in the Long Run					
273	Stone, sand and gravel (0.02)	90	2.99 (9.56)	-5.26 (1.59)	1.82 (2.02)
282	Iron and steel scrap (0.62)	20	1.03 (14.90)	-1.84 (2.41)	0.41 (2.17)
515	Radioactive and associated material (0.43)	28	3.14 (11.58)	-10.03 (2.43)	1.44 (1.94)
554	Soaps,cleansing & polishing prepara (0.23)	38	1.61 (13.36)	-0.66 (0.36)	1.63 (2.73)
653	Text fabrics woven ex narrow, spec (0.04)	79	1.71 (3.79)	-6.87 (1.43)	2.42 (2.19)
665	Glassware (0.22)	42	1.94 (26.97)	-9.83 (6.71)	0.20 (2.03)
684	Aluminium (0.27)	35	1.91 (8.17)	-8.66 (2.57)	1.47 (1.86)
711	Power generating machinery, other t (2.36)	6	1.49 (22.31)	-3.57 (3.11)	0.63 (2.46)
725	Domestic electrical equipment (0.10)	58	2.21 (19.34)	-9.23 (3.68)	0.69 (2.21)
731	Railway vehicles (0.06)	69	0.81 (7.23)	-8.23 (3.99)	1.01 (2.09)
862	Photographic and cinematographic su (0.13)	52	1.79 (7.31)	-3.22 (1.42)	1.75 (2.21)
895	Office and stationery supplies, nes (0.03)	80	1.87 (15.03)	-6.11 (3.16)	0.83 (2.57)
Negatively affected by exchange-rate volatility in the Long Run					
054	Vegetables, roots & tubers, fresh o (0.13)	53	2.18 (15.20)	-7.05 (3.26)	-0.91 (2.24)
663	Mineral manufactures, nes (0.23)	40	1.76 (8.20)	-1.52 (0.56)	-0.54 (1.87)
651	Textile yarn and thread (0.12)	56	1.54 (14.18)	-0.72 (0.45)	-0.63 (1.73)
841	Clothing except fur clothing (0.17)	45	1.24 (7.72)	4.12 (1.78)	-0.65 (1.88)
Not affected by exchange-rate volatility in the Long Run but Cointegrated					

013	Meat in airtight containers nes & m (0.05)	74	2.96 (7.80)	-18.48 (2.66)	1.58 (1.30)
022	Milk and cream (0.08)	64	0.97 (1.99)	-15.07 (2.03)	0.04 (0.03)
024	Cheese and curd (0.07)	66	1.98 (6.83)	0.88 (0.23)	-1.21 (1.08)
044	Maize-corn–unmilled (2.35)	7	0.61 (1.72)	-6.62 (1.29)	-1.09 (0.80)
048	Cereal preps & preps of flour of fr (0.10)	59	1.49 (6.51)	-2.91 (1.06)	-0.11 (0.38)
053	Fruit,preserved and fruit preparati (0.16)	48	1.77 (31.93)	-4.60 (5.64)	-0.11 (1.60)
055	Vegetables, roots & tubers pres or (0.06)	71	2.19 (16.30)	-12.11 (4.73)	0.44 (0.94)
061	Sugar and honey (0.05)	77	1.63 (6.98)	-2.26 (0.83)	0.47 (1.15)
062	Sugar confy, sugar preps. ex chocol (0.03)	83	2.01 (8.40)	-2.75 (0.69)	-0.46 (0.53)
073	Chocolate & other food preptns cont (0.13)	54	2.16 (6.26)	-0.01 (0.00)	-0.57 (0.55)
091	Margarine & shortening (0.005)	94	1.24 (3.49)	-0.32 (0.08)	0.14 (0.33)
099	Food preparations, nes (0.03)	84	1.69 (8.97)	-3.61 (1.53)	-0.00 (0.02)
112	Alcoholic beverages (0.13)	55	1.78 (10.34)	-1.06 (0.43)	-0.12 (0.26)
231	Crude rubber-incl.synthetic & recla (0.25)	36	1.38 (4.14)	-6.83 (1.53)	0.41 (0.81)
266	Synthetic and regenerated-artificia (0.06)	72	0.81 (3.11)	-3.01 (0.75)	-0.27 (0.78)
267	Waste materials from textile fabric (0.004)	95	0.72 (2.00)	-11.19 (2.12)	-0.37 (0.79)
411	Animal oils and fats (0.06)	70	-0.53 (1.22)	-9.78 (1.87)	-1.89 (1.20)
514	Other inorganic chemicals (0.35)	31	1.55 (10.72)	-2.34 (1.41)	0.14 (0.82)
531	Synth.organic dyestuffs, natural ind (0.03)	82	0.96 (0.35)	2.32 (0.51)	-0.03 (0.05)
541	Medicinal & pharmaceutical products (0.86)	19	2.25 (2.12)	-24.09 (0.99)	5.03 (0.92)
581	Plastic materials,regenerd.cellulos (2.77)	5	1.61 (9.22)	-6.64 (2.39)	0.14 (0.59)
629	Articles of rubber, nes (0.08)	65	2.03 (7.47)	4.05 (1.02)	-0.09 (0.26)
641	Paper and paperboard (0.55)	24	1.96 (10.41)	-2.93 (0.93)	0.07 (0.33)
642	Articles of paper, pulp, paperboard (0.05)	76	1.51 (3.72)	-22.17 (2.02)	0.23 (0.48)
653	Perfumery, cosmetics, dentifrices (0.52)	25	2.42 (17.57)	-5.29 (3.30)	0.62 (1.27)
656	Made-up articles,wholly or chiefly (0.01)	93	1.59 (6.85	-2.18 (0.76)	0.24 (0.75)
673	Iron and steel bars,rods,angles,sha (0.05)	75	1.09 (6.29)	-5.13 (2.01)	0.26 (0.62)
678	Tubes,pipes and fittings of iron or (0.20)	43	0.99 (4.40)	-8.33 (1.82)	0.09 (0.14)
679	Iron steel castings forgings unwork (0.03)	81	1.83 (10.47)	-4.02 (2.16)	0.41 (0.84)
682	Copper (0.17)	46	1.26 (8.44)	0.39 (0.23)	0.19 (1.09)
691	Finished structural parts and struc (0.08)	63	0.94 (4.18)	-4.04 (1.14)	-0.18 (0.26)
692	Metal containers for storage and tr (0.09)	62	1.64 (13.05)	-3.11 (1.74)	-0.18 (1.03)

695	Tools for use in the hand or in mac (0.09)	61	1.54 (19.69)	-4.66 (3.84)	0.41 (1.49)
698	Manufactures of metal, nes (0.24)	37	0.93 (6.74)	-1.02 (0.62)	-0.13 (0.31)
712	Agricultural machinery and implement (0.16)	49	1.10 (15.21)	-4.02 (4.76)	0.07 (0.77)
715	Metalworking machinery (2.32)	8	1.22 (7.61)	-0.83 (0.30)	-0.48 (0.83)
717	Textile and leather machinery (0.06)	73	0.91 (12.19)	-3.08 (2.25)	0.41 (1.28)
719	Machinery and appliances-non electr (9.09)	2	1.55 (15.70)	-5.96 (2.94)	-0.06 (0.47)
722	Electric power machinery and switch (1.77)	11	1.33 (13.35)	0.91 (0.32)	-0.15 (0.98)
723	Equipment for distributing electric (0.18)	44	1.91 (6.81)	-5.41 (1.23)	0.03 (0.09)
724	Telecommunications apparatus (1.77)	12	1.63 (11.43)	-8.05 (3.08)	0.79 (1.54)
726	Elec.apparatus for medic.purp., radi (0.59)	23	1.29 (2.24)	-24.11 (1.17)	-2.61 (1.25)
729	Other electrical machinery and appa (17.91)	1	1.13 (6.54)	-3.04 (1.94)	0.33 (0.79)
732	Road motor vehicles (1.98)	10	1.48 (40.71)	-5.64 (9.25)	0.02 (0.35)
733	Road vehicles other than motor vehi (0.15)	50	0.97 (12.12)	0.46 (0.36)	-0.33 (1.57)
812	Sanitary, plumbing heating & lightin (0.07)	68	1.56 (4.91)	-7.79 (1.36)	2.05 (1.45)
821	Furniture (0.17)	47	2.06 (7.13)	-7.19 (1.21)	-0.32 (0.34)
861	Scientific,medical,optical,meas./co (5.53)	3	1.81 (24.05)	-2.98 (3.04)	-0.16 (1.56)
864	Watches and clocks (0.02)	89	0.72 (2.30)	-1.54 (0.43)	0.86 (1.55)
891	Musical instruments,sound recorders (0.89)	17	2.09 (26.69)	-2.48 (1.74)	0.06 (0.22)
892	Printed matter (0.37)	30	1.58 (12.04)	-5.73 (2.16)	0.09 (0.52)
893	Articles of artificial plastic mate (0.32)	34	2.20 (7.27)	-4.32 (1.12)	0.93 (1.14)
894	Perambulators, toys, games and sporti (0.39)	29	3.08 (8.89)	-7.29 (1.60)	1.13 (1.18)
Not	***affected by exchange-rate volatility in the Long Run and not Cointegrated***				
041	Wheat- including spelt- and mesli (0.61)	21	-0.67 (0.68)	1.63 (0.29)	-2.15 (0.79)
081	Feed.-stuff for animals excl.unmill (0.60)	22	-0.01 (0.00)	-66.97 (0.62)	-2.75 (0.60)
211	Hides & skins,-exc.fur skins- under (1.04)	15	-20.3 (0.12)	179.98 (0.13)	34.65 (0.14)
242	Wood in the rough or roughly square (0.34)	32	3.14 (2.15)	-10.42 (1.25)	-1.28 (1.26)
243	Wood, shaped or simply worked (0.07)	67	2.87 (2.03)	-27.33 (1.14)	3.42 (0.79)
251	Pulp & waste paper (0.89)	16	1.66 (2.06)	-9.21 (0.63)	9.33 (0.64)
263	Cotton (0.33)	33	-2.29 (0.39)	24.53 (0.39)	1.70 (0.43)
275	Natural abrasives-incl.industrial d (0.02)	91	1.26 (1.24)	-28.49 (1.15)	1.80 (0.89)
291	Crude animal materials, nes (0.03)	85	1.05 (1.10)	-12.11 (1.24)	3.87 (1.29)
332	Petroleum products (1.15)	14	0.74 (0.57)	-10.63 (0.78)	-3.39 (1.02)

512	Organic chemicals (5.30)	4	0.89 (0.81)	6.83 (0.64)	-0.02 (0.02)
513	Inorg.chemicals-elems., oxides, halog (0.87)	18	0.91 (1.33)	-11.15 (0.92)	1.72 (0.72)
551	Essential oils, perfume and flavor (0.05)	78	0.33 (0.18)	1.99 (0.18)	-0.24 (0.19)
599	Chemical materials and products, nes (1.70)	13	1.46 (5.56)	-14.46 (1.22)	0.84 (0.79)
655	Special textile fabrics and related (0.15)	51	1.69 (10.12)	-4.48 (1.51)	0.10 (0.51)
661	Lime,cement & fabr.bldg.mat.-ex gla (0.03)	86	5.33 (1.27)	-19.36 (0.79)	11.12 (0.78)
662	Clay and refractory construction ma (0.23)	39	1.51 (3.80)	-10.41 (0.90)	1.54 (0.88)
664	Glass (0.22)	41	1.83 (4.27)	-15.74 (1.28)	2.72 (1.30)
674	Universals,plates and sheets of iro (0.11)	57	1.78 (1.59)	-62.64 (0.80)	2.10 (0.38)
677	Iron and steel wire, excluding wire (0.02)	92	2.42 (1.88)	-34.87 (1.02)	2.23 (0.64)
693	Wire products – ex electric - & fen (0.03)	87	2.09 (1.99)	0.59 (0.08)	3.55 (0.83)
694	Nails, screws, nuts, bolts, rivets (0.10)	60	1.48 (3.70)	-0.46 (0.06)	-0.89 (1.25)
697	Household equipment of base metals (0.03)	88	6.64 (0.22)	-154.36 (0.15)	42.09 (0.16)
714	Office machines (2.02)	9	1.82 (4.46)	-17.26 (1.37)	0.97 (1.13)
718	Machines for special industries (0.46)	27	0.53 (0.43)	-35.06 (0.76)	1.56 (0.71)
863	Developed cinematographic film (0.004)	96	1.24 (2.33)	-2.50 (0.46)	0.77 (0.63)
899	Manufactured articles, nes (0.50)	26	6.27 (0.17)	-83.62 (0.12)	-29.5 (0.11)

Notes: The number inside the parenthesis next to the name of each industry is that industry's trade share. Number inside the parenthesis next to estimated coefficient is the absolute value of the t-ratio. We use critical values of 1.64 at the 10% significance level and 1.96 at the 5% significance level.

Table 3. Short- and Long-Run Coefficient Estimates for Import Model (4)

Short-Run Coefficient Estimates

Code	Name	Share rank	$\Delta \ln VOL_t$	$\Delta \ln VOL_{t-1}$	$\Delta \ln VOL_{t-2}$	$\Delta \ln VOL_{t-3}$
TTX	Total imports		0.05 (2.14)			
Positively affected by exchange-rate volatility						
632	Wood manufactures,nes (0.01)	25	0.27 (3.53)			
724	Telecommunications apparatus (14.79)	1	0.11 (1.59)	-0.35 (1.86)	-0.22 (1.53	-0.19 (2.08)
729	Other electrical machinery and appa (8.19)	2	0.09 (1.91)			
831	Travel goods, handbags and similar (0.05)	19	-0.04 (0.78)	-0.28 (2.58)	-0.14 (1.81)	-0.05 (1.12)
899	Manufactured articles, nes (0.19)	13	-0.08 (2.15)	-0.22 (3.13)	-0.10 (2.53)	
Negatively affected by exchange-rate volatility						
291	Crude animal materials,nes (0.001)	29	-0.25 (1.74)	0.75 (3.43)	0.46 (3.16)	

891	Musical instruments,sound recorders (1.07)	5	-0.17 (2.97)			
Not affected by exchange-rate volatility but Cointegrated						
055	Vegetables, roots & tubers pres or (0.01)	26	0.16 (1.55)			
276	Other crude minerals (0.003)	28	-0.05 (0.40)	-0.30 (1.89)		
631	Veneers,plywood boards & other wood (0.004)	27	-0.02 (0.12)			
656	Made-up articles,wholly or chiefly (0.16)	14	-0.02 (0.43)			
664	Glass (0.05)	20	0.05 (0.60)	0.18 (1.25)	0.17 (2.01)	
698	Manufactures of metal, nes (0.61)	8	0.19 (2.47)	0.13 (0.92)	0.12 (1.43)	
821	Furniture (0.32)	11	-0.06 (0.73)			
851	Footwear (0.04)	23	0.00 (0.08)			
894	Perambulators,toys,games and sporti (0.44)	9	-0.05 (0.96)			
897	Jewellery and gold/silver-smiths wa (0.16)	15	-0.02 (0.36)			
Not affected by exchange-rate volatility and not Cointegrated						
031	Fish,fresh & simply preserved (0.09)	16	0.19 (1.68)	0.14 (1.14)		
032	Fish,in airtight containers,nes & f (0.07)	18	-0.04 (0.50)			
292	Crude vegetable materials,nes (0.05)	21	-0.11 (1.03)			
512	Organic chemicals (1.56)	4	0.15 (0.96)			
641	Paper and paperboard (1.02)	7	0.18 (2.37)			
652	Cotton fabrics,woven ex.narrow or s (0.23)	12	-0.07 (1.15)			
653	Text fabrics woven ex narrow, spec, (1.04)	6	0.03 (0.68)	0.06 (1.53)		
666	Pottery (0.02)	24	-0.17 (1.30)			
812	Sanitary,plumbing,heating & lightin (0.08)	17	0.07 (1.11)	0.06 (0.52)	0.12 (1.69)	
841	Clothing except fur clothing (2.22)	3	0.04 (1.47)	-0.08 (2.41)		
892	Printed matter (0.41)	10	0.04 (0.70)			
896	Works of art,collectors pieces and (0.05)	22	0.16 (1.45)	0.42 (1.96)	0.34 (2.51)	

Long-Run Coefficient Estimates

Code	Name	Share rank	$\ln Y^{U.S.}$	$\ln REX$	$\ln VOL$
TTX	Total imports		-2.96 (1.42)	1.34 (0.37)	0.49 (1.98)
Positively affected by exchange-rate volatility					
632	Wood manufactures,nes (0.01)	25	-0.21 (0.29)	0.72 (0.32)	1.03 (3.61)
724	Telecommunications apparatus (14.79)	1	-4.41 (0.85)	-1.41 (0.15)	4.96 (1.94)

729	Other electrical machinery and appa (8.19)	2	4.74 (9.33)	-5.40 (2.61)	0.31 (1.96)
831	Travel goods, handbags and similar (0.05)	19	-1.96 (1.27)	0.29 (0.08)	3.01 (3.47)
899	Manufactured articles, nes (0.19)	13	1.53 (5.02)	-0.55 (0.42)	0.75 (2.37)
Negatively affected by exchange-rate volatility					
291	Crude animal materials,nes (0.001)	29	2.16 (2.07)	8.20 (1.81)	-2.29 (2.02)
891	Musical instruments,sound recorders (1.07)	5	-0.19 (0.07)	13.82 (1.75)	-1.41 (2.22)
Not affected by exchange-rate volatility but Cointegrated					
055	Vegetables, roots & tubers pres or (0.01)	26	-3.93 (1.92)	5.29 (0.85)	0.78 (1.38)
276	Other crude minerals (0.003)	28	1.83 (1.14)	1.96 (0.23)	1.74 (1.26)
631	Veneers,plywood boards & other wood (0.004)	27	-18.23 (6.94)	0.05 (0.00)	-0.06 (0.12)
656	Made-up articles,wholly or chiefly (0.16)	14	13.08 (1.93)	-39.30 (1.25)	0.27 (0.39)
664	Glass (0.05)	20	106.4 (0.14)	-87.04 (0.14)	18.25 (0.13)
698	Manufactures of metal, nes (0.61)	8	-17.4 (0.73)	6.60 (0.27)	-1.31 (0.28)
821	Furniture (0.32)	11	0.44 (0.17)	6.17 (0.80)	-0.44 (0.71)
851	Footwear (0.04)	23	31.46 (1.21)	-40.93 (1.08)	-0.12 (0.08)
894	Perambulators,toys,games and sporti (0.44)	9	-0.34 (0.10)	-0.53 (0.06)	0.36 (0.35)
897	Jewellery and gold/silver-smiths wa (0.16)	15	-5.79 (0.51)	26.03 (0.80)	-0.45 (0.35)
Not affected by exchange-rate volatility and not Cointegrated					
031	Fish,fresh & simply preserved (0.09)	16	-39.19 (0.30)	126.88 (0.30)	10.81 (0.33)
032	Fish,in airtight containers,nes & f (0.07)	18	-3.92 (0.63)	13.78 (0.92)	-0.46 (0.47)
292	Crude vegetable materials,nes (0.05)	21	0.43 (0.13)	6.23 (0.49)	-0.73 (0.74)
512	Organic chemicals (1.56)	4	-44.65 (0.10)	182.69 (0.11)	13.47 (0.12)
641	Paper and paperboard (1.02)	7	2.89 (1.45)	-5.36 (0.82)	3.22 (1.48)
652	Cotton fabrics,woven ex.narrow or s (0.23)	12	7.27 (2.89)	-0.54 (0.15)	0.42 (0.91)
653	Text fabrics woven ex narrow, spec, (1.04)	6	24.26 (0.25)	86.19 (0.19)	-1.67 (0.12)
666	Pottery (0.02)	24	-11.24 (0.68)	13.38 (0.47)	2.91 (0.74)
812	Sanitary,plumbing,heating & lightin (0.08)	17	15.33 (8.27)	-19.72 (4.26)	0.00 (0.01)
841	Clothing except fur clothing (2.22)	3	-5.03 (0.99)	-12.53 (1.52)	3.74 (1.52)
892	Printed matter (0.41)	10	13.17 (8.45)	-18.85 (3.68)	-0.25 (0.74)
896	Works of art,collectors pieces and (0.05)	22	-2.06 (0.41)	16.58 (1.03)	-3.05 (1.08)

Notes: The number inside the parenthesis next to the name of each industry is that industry's trade share. Number inside the parenthesis next to estimated coefficient is the absolute value of the t-ratio. We use critical values of 1.64 at the 10% significance level and 1.96 at the 5% significance level.

As for the factors explaining the significant long-run effects of volatility on the aggregate bilateral trade flows versus long-run insignificant effects in most industries, our conjecture is that not all of the industries that make up total exports and imports are included in this sample and in bilateral trade data. In fact, while the 96 export industries make up 70 percent of the total, the 29 import industries make up only 33 percent of total imports. Therefore, the significant long-run impact of exchange rate volatility on total U.S. export to Korea could stem from the 16 cointegrated industries identified in Table 2 plus those industries that lack data and make up 30% of market share. On the import side, 67% of trade is conducted by industries for which no data are available, and obviously those industries plus seven cointegrated industries identified in Table 3 are the main contributing industries to the overall effect.

For the rest of the industries -80 of 96 export industries and 22 of 29 import industries- there seems to be little relationship between exchange-rate volatility and trade flows in the long run. What are some possible explanations? First, as is shown in Figure 2, exchange-rate volatility is fairly low. It is possible that other costs, particularly transport costs, might outweigh the role of risk in determining the trader's decision. Indeed, Bailey *et al*. (1987, p. 228) argue that opportunities for profit that vary directly with exchange rate risk could offset the risk on trade, leaving trade flows unaffected. The authors argue that one could question whether the variability of a bilateral exchange rate measures the risk to the firm. At times governments intervene in the foreign exchange market through quantitative restrictions to reduce exchange rate variability. The cost of such restrictions to an exporting firm could be higher than any cost associated with exchange rate variability, leaving the measure of exchange rate variability and a firm's cost to be uncorrelated.

Secondly, many of the large industries (such as U.S. machinery exports or telecommunications imports) may have a large share of intra-industry trade. As Bahmani-Oskooee and Hegerty (2009a) show for U.S.-Mexico trade, large corporations engaging in intraindustry trade can reduce the risk they face from cross-border trade. The intraindustry insensitivity of U.S.-Korea trade flows in itself can contribute to the insignificant results in the long run. For instance, when there is a tendency for exchange rates to adjust to differences in inflation rates, the loss to the exporter from a depreciating foreign currency can be offset by the higher foreign-currency export price if exports are priced in a foreign currency. In a similar vein, to the extent that an exporter imports intermediate inputs from a country whose currency is depreciating, there will be some offset to declining export revenue in the form of lower input costs. In addition, when a firm trades with a large number of countries, the tendency for some exchange rates to move in offsetting directions will provide a degree of protection to its overall exposure to currency risk.

Diagnostic statistics are given in Tables 4 and 5. Our Lagrange Multiplier statistics show that most models are free of autocorrelation, while the RESET test for functional form points toward correct specification. In addition, the cumulative sums of residuals and squared residuals suggest that the majority of models are stable. Finally, a high

adjusted R-squared shows that the models have good explanatory power.

Table 4. Diagnostic Statistics for Export Model (3)

CODE	Industry	LM	RESET	CUSUM	CUSUMSQ	Adj. R2
TTX	Total exports	0.91	0.06	S	S	0.64
013	Meat in airtight containers nes & m	0.66	3.16	S	S	0.17
048	Cereal preps & preps of flour of fr	1.87	1.45	S	U	0.32
053	Fruit,preserved and fruit preparati	0.10	0.36	S	S	0.57
055	Vegetables, roots & tubers pres or	1.19	1.87	S	S	0.27
411	Animal oils and fats	18.79	0.19	S	S	0.26
514	Other inorganic chemicals	8.44	0.17	U	U	0.06
515	Radioactive and associated material	5.00	0.04	S	U	0.18
531	Synth.organic dyestuffs,natural ind	3.08	5.74	S	U	0.14
541	Medicinal & pharmaceutical products	8.19	1.87	S	U	0.33
642	Articles of paper, pulp, paperboard	0.57	0.42	S	S	0.24
651	Textile yarn and thread	1.85	6.99	S	U	0.21
656	Made-up articles, wholly or chiefly	0.03	0.00	S	U	0.26
673	Iron and steel bars, rods, angles, sha	5.76	0.00	S	S	0.09
678	Tubes, pipes and fittings of iron or	0.09	2.17	S	S	0.55
679	Iron steel castings forgings unwork	1.13	0.69	S	U	0.29
682	Copper	0.60	0.87	S	U	0.24
684	Aluminium	1.21	1.32	S	S	0.24
691	Finished structural parts and struc	5.23	5.48	S	S	0.12
692	Metal containers for storage and tr	2.59	3.43	S	S	0.53
695	Tools for nse in the hand or in mac	0.66	0.01	S	S	0.29
712	Agricultural machinery and implemen	2.87	0.98	S	S	0.42
719	Machinery and appliances-non electr	0.62	0.12	S	S	0.57
723	Equipment for distributing electric	0.69	1.33	S	S	0.35
725	Domestic electrical equipment	0.68	2.82	S	S	0.31
726	Elec.apparatus for medic.purp.,radi	5.24	0.07	U	U	0.29
731	Railway vehicles	1.36	0.03	S	S	0.81
732	Road motor vehicles	1.81	4.49	S	S	0.51
733	Road vehicles other than motor vehi	5.55	1.31	S	S	0.41
821	Furniture	3.06	6.76	S	S	0.36
841	Clothing except fur clothing	1.41	5.91	S	S	0.21
861	Scientific,medical,optical,meas./co	1.85	0.04	S	U	0.28
862	Photographic and cinematographic su	6.26	0.04	S	U	0.09
864	Watches and clocks	0.32	1.61	U	S	-0.02
895	Office and stationery supplies, nes	0.46	0.00	S	U	0.26
022	Milk and cream	2.19	2.96	S	S	0.08
024	Cheese and curd	1.39	1.43	S	S	0.15
041	Wheat - including spelt - and mesli	0.28	3.62	S	S	0.18
044	Maize - corn - unmilled	1.39	0.03	S	S	0.39
054	Vegetables, roots & tubers, fresh o	1.47	5.9	S	S	0.64

061	Sugar and honey	0.01	3.97	S	U	0.08
062	Sugar confy, sugar preps. ex chocol	0.09	0.06	S	S	0.43
073	Chocolate & other food preptns cont	0.02	4.19	S	S	0.35
081	Feed.-stuff for animals excl.unmill	0.17	0.54	S	S	0.01
091	Margarine & shortening	1.90	2.98	S	S	-0.01
099	Food preparations,nes	2.17	0.01	S	S	0.15
112	Alcoholic beverages	0.31	1.25	S	S	0.45
211	Hides & skins,-exc.fur skins- undre	1.50	0.09	S	S	0.53
231	Crude rubber-incl.synthetic & recla	0.17	1.12	S	U	0.02
242	Wood in the rough or roughly square	0.22	0.72	U	S	0.40
243	Wood,shaped or simply worked	0.15	2.34	S	S	0.48
251	Pulp & waste paper	0.13	0.02	S	S	0.38
263	Cotton	0.12	3.69	S	S	0.47
266	Synthetic and regenerated-artificia	1.16	8.25	S	U	0.18
267	Waste materials from textile fabric	0.06	0.92	S	S	0.04
273	Stone, sand and gravel	1.07	0.44	U	U	0.21
275	Natural abrasives-incl.indnstrial d	0.46	0.54	S	U	1.58
282	Iron and steel scrap	2.00	1.62	S	S	0.17
291	Crude animal materials,nes	0.18	4.08	S	S	0.00
332	Petroleum products	0.50	0.09	S	S	0.28
512	Organic chemicals	4.73	0.17	U	S	0.10
513	Inorg.chemicals-elems.,oxides,halog	0.55	1.99	S	S	0.50
551	Essential oils, perfume and flavour	9.02	0.05	S	S	0.31
553	Perfumery, cosmetics, dentifrices,	1.45	0.28	S	S	0.61
554	Soaps,cleansing & polishing prepara	0.87	3.42	S	S	0.35
581	Plastic materials,regenerd.cellulos	0.12	1.93	S	U	0.27
599	Chemical materials and products, nes	0.57	2.64	S	S	0.59
629	Articles of rubber, nes	0.13	4.09	S	S	0.20
641	Paper and paperboard	0.69	0.86	S	S	0.43
653	Text fabrics woven ex narrow, spec,	1.24	7.58	S	S	0.05
655	Special textile fabrics and related	0.01	0.61	S	S	0.20
661	Lime,cement & fabr.bldg.mat.-ex gla	0.20	0.81	S	S	0.24
662	Clay and refractory construction ma	0.15	5.15	S	S	0.51
663	Mineral manufactures, nes	1.11	6.35	S	U	0.15
664	Glass	0.31	1.57	S	S	0.32
665	Glassware	1.37	1.23	S	S	0.69
674	Universals,plates and sheets of iro	0.21	6.65	S	U	0.42
677	Iron and steel wire, excluding wire	0.80	2.09	S	S	0.44
693	Wire products - ex electric - & fen	0.09	1.22	S	S	0.10
694	Nails,screws,nuts,bolts,rivets and	1.15	0.01	S	S	0.44
697	Household equipment of base metals	7.51	1.18	S	S	0.17
698	Manufactures of metal, nes	0.13	12.9	S	S	0.65
711	Power generating machinery, other t	0.36	0.36	S	S	0.49
714	Office machines	0.90	0.97	S	S	0.44
715	Metalworking machinery	0.12	0.52	S	S	0.48
717	Textile and leather machinery	2.14	1.93	S	S	0.66

718	Machines for special industries	0.02	2.94	S	S	0.47
722	Electric power machinery and switch	0.15	5.77	S	S	0.54
724	Telecommunications apparatus	1.44	8.59	S	S	0.54
729	Other electrical machinery and appa	0.16	2.07	S	S	0.63
812	Sanitary,plumbing,heating & lightin	1.97	4.85	S	S	0.31
863	Developed cinematographic film	5.24	0.44	S	S	0.49
891	Musical instruments,sound recorders	4.22	3.86	S	S	0.24
892	Printed matter	2.12	0.03	S	S	0.31
893	Articles of artificial plastic mate	0.03	0.27	S	S	0.37
894	Perambulators,toys,games and sporti	0.69	0.06	S	S	0.22
899	Manufactured articles, nes	4.47	10.54	S	S	0.27

Notes: LM = Lagrange multiplier test of residual serial correlation. It is distributed as $\chi^2_{(1)}$. RESET = Ramsey's test for functional form. It is distributed as $\chi^2_{(1)}$. CUSUM = Cumulative sum of residuals; S = "Stable," U = "Unstable." CUSUMSQ = Cumulative sum of squared residuals; S = "Stable," U = "Unstable."

Table 5. Diagnostic Statistics for Import Model (4)

Code	Industry	LM	RESET	CUSUM	CUSUMSQ	Adj. R2
TTM	Total imports	10.5	0.28	S	S	0.52
055	Vegetables, roots & tubers pres or	0.17	3.27	U	S	0.12
276	Other crude minerals	0.53	1.18	S	S	0.30
291	Crude animal materials,nes	2.69	5.81	S	S	0.18
632	Wood manufactures,nes	7.57	9.69	S	U	0.33
656	Made-up articles,wholly or chiefly	1.91	3.68	S	S	0.19
664	Glass	3.09	14.15	S	S	0.47
698	Manufactures of metal, nes	3.16	0.04	S	S	-0.01
729	Other electrical machinery and appa	4.87	6.81	S	S	0.25
821	Furniture	0.16	1.07	S	U	0.19
831	Travel goods, handbags and similar	2.17	0.08	S	S	0.58
851	Footwear	5.51	1.03	U	S	0.38
891	Musical instruments, sound recorders	5.56	0.32	U	S	0.34
894	Perambulators,toys,games and sporti	0.52	1.48	S	S	0.46
897	Jewellery and gold/silver-smiths wa	2.69	1.00	U	S	0.49
031	Fish,fresh & simply preserved	2.43	10.37	S	S	0.06
032	Fish,in airtight containers,nes & f	0.94	0.00	U	S	0.33
292	Crude vegetable materials,nes	0.01	0.62	S	U	0.19
512	Organic chemicals	0.04	14.08	S	S	0.26
631	Veneers, plywood boards & other wood	2.58	1.88	S	S	0.10
641	Paper and paperboard	2.98	2.37	S	S	-0.04
652	Cotton fabrics,woven ex.narrow or s	1.68	11.61	U	U	0.25
653	Text fabrics woven ex narrow, spec,	3.87	2.83	S	S	0.06
666	Pottery	0.01	3.47	S	S	0.05
724	Telecommunications apparatus	0.62	6.74	S	S	0.36
812	Sanitary, plumbing, heating & lightin	5.17	1.29	S	S	0.39

841	Clothing except fur clothing	0.72	1.08	S	S	0.60
892	Printed matter	1.58	0.05	S	S	0.23
896	Works of art, collectors pieces and	1.02	0.57	S	S	0.28
899	Manufactured articles, nes	3.63	3.25	S	U	0.22

Notes: The numbers inside the parentheses are the absolute value of the t-ratios. LM = Lagrange multiplier test of residual serial correlation. It is distributed as $\chi^2_{(1)}$. RESET = Ramsey's test for functional form. It is distributed as $\chi^2_{(1)}$. CUSUM = Cumulative sum of residuals; S = "Stable," U = "Unstable." CUSUMSQ = Cumulative sum of squared residuals; S = "Stable," U = "Unstable."

4. CONCLUSION

With the fairly recent development of cointegration techniques and the availability of industry-level bilateral trade data, empirical studies have been able to address the differing effects of exchange-rate volatility at the bilateral and the industry level. Because traders may be risk-averse, it is possible that this volatility might reduce trade flows; theoretical and empirical literature has shown that it might actually increase trade or have no effect at all.

This study extends the literature to the trade relationship between the United States and South Korea, also finding that the results are mixed. Applying the ARDL cointegration methodology of Pesaran *et al.* (2001) to annual data from 1965 to 2006, we examine U.S. exports to Korea at the bilateral level and for 96 individual industries. In addition, we also look at bilateral imports and 29 individual industries.

We find that in most industries exchange rate uncertainty has short-run effects. In the long run, however, for those industries that do have a cointegrating relationship, exchange-rate volatility has a significant effect on only a small fraction. While both bilateral exports and bilateral imports respond positively to increased uncertainty, few industries have significant volatility coefficients in the long run. In all, while 12 export and five import industries respond positively to exchange-rate volatility, four export and two import industries respond negatively. Furthermore, the majority of the affected industries are small as measured by their trade share. In most industries, the level of economic activity seems to be the major player in the long run.

APPENDIX

Data Definition and Sources

We use annual data over the period 1965-2006 in our empirical analysis. The data come from the following sources:

a. World Bank
b. International Financial Statistics of the IMF (www.imfstatistics.org).

Variables:

VX = For each industry *i*, *VX* is defined as the volume of U.S. exports to Korea. Export value data in U.S. dollars for each commodity come from source *a*. In the absence of annual price levels for each commodity, following Bahmani-Oskooee and Ardalani (2006) we deflate each industry's trade value by the U.S. export unit value (source *b*).

VM = For each industry *i*, *VM* is defined as the volume of U.S. imports from Korea. Import value data in U.S. dollars for each commodity comes from source *a*. Again, in the absence of annual price levels for each commodity, we deflate each industry's trade value by Korea's import unit value (source *b*).

$Y^{U.S.}$ = Measure of U.S. income. It is proxied by real GDP (source *b*).

Y^{Korea} = Korea's real GDP (source *b*).

REX = Real won-dollar bilateral exchange rate, defined as ($PPI^{U.S.}$ *x* NEX/ PPI^{Korea}), *PPI* is the Producer Price Index and *NEX* is the nominal bilateral exchange rate defined as number of won per dollar. Thus, a decrease reflects a real depreciation of the dollar. All data are from source *b*.

VOL = Volatility measure of the real bilateral exchange rate (*REX*). Following Bahmani-Oskooee and Hegerty (2009a), it is the standard deviation of the 12 monthly real exchange rate (*REX*) values within that year. Monthly *PPI* and nominal exchange rate data come from source *b*.

REFERENCES

Akhtar, M.A., and R.S. Hilton (1984), "Effects of Uncertainty on German and U.S. Trade," *Federal Reserve Bank of New York Quarterly Review*, Spring, 7-16.

Arize, A.C., J. Malindretos, and K.M. Kasibhatle (2003), "Does Exchange-Rate Volatility Depress Export Flows? The Case of LDCs," *Journal of International Advances in Economic Research*, 82-100.

Arize, A.C., T. Osang, and D.J. Slottje (2000), "Exchange-Rate Volatility and Foreign Trade: Evidence from Thirteen LDCs." *Journal of Business and Economic Statistics*, 18(1), 10-17.

Baak, S.J., M.A. Al-Mahmood, and S. Vixathep (2007), "Exchange Rate Volatility and Exports From east Asian Countries to Japan and the USA," *Applied Economics*, 39, 947-959.

Bahmani-Oskooee, M. (1996), "Exchange Rate Uncertainty and Trade Flows of LDCs: Evidence from Johansen's Cointegration Analysis," *Journal of Economic Development*,

21, 23-35.

Bahmani-Oskooee, M., and Z. Ardalani (2006), "Exchange Rate Sensitivity of U.S. Trade Flows: Evidence from Industry Data," *Southern Economic Journal*, 72, 542-559.

Bahmani-Oskooee, M., and A. Gelan (2009), "How Stable is the Demand for Money in African Countries," *Journal of Economic Studies*, 36, 216-235.

Bahmani-Oskooee, M., and S.W. Hegerty (2007), "Exchange Rate Volatility and Trade Flows: A Review Article," *Journal of Economic Studies*, 34(3), 211-255.

_____ (2009a), "The Effects of Exchange-Rate Volatility on Commodity Trade Between the U.S. and Mexico," *Southern Economic Journal*, 79, 1019-1044.

_____ (2009b), "Exchange-Rate Risk and U.S.-Japan Trade: Evidence from Industry Level Data," *Journal of the Japanese and International Economies*, 22(4), 518-534.

Bahmani-Oskooee, M., and S. Payesteh (1993), "Does Exchange Rate Volatility Deter Trade Flows of LDCs?" *Journal of Economic Development,* 18, 189-205.

Bailey, M.J., G.S. Tavlas, and M. Ulan (1987), "The Impact of Exchange Rate Volatility on Export Growth: Some Theoretical Considerations and Empirical Results," *Journal of Policy Modeling*, 9, 225-243.

Broll, U., and B. Eckwert (1999), "Exchange Rate Volatility and International Trade," *Southern Economic Journal*, 66(1), 178-185.

Doğanlar, M. (2002), "Estimating the Impact of Exchange Rate Volatility on Exports: Evidence from Asian Countries," *Applied Economics Letters*, 9, 859-863.

Domac, I. (1997), "Are Devaluations Contractionary? Evidence from Turkey," *Journal of Economic Development*, 22, 145-163.

Doroodian, K. (1999), "Does Exchange Rate Volatility Deter International Trade in Developing Countries?" *Journal of Asian Economics*, 10, 465-474.

Engle, R.F., and C.W.J. Granger (1987), "Co-integration and Error-Correction: Representation, Estimation and Testing," *Econometrica*, 55, 1251-1276.

Giorgioni, G., and J.L. Thompson (2002), "Which Volatility? The Case of the Exports of Wheat," *Applied Economics Letters*, 9(10), 681-684.

Halicioglu, F., (2007), "The J-Curve Dynamics of Turkish Bilateral Trade: A Cointegration Approach," *Journal of Economic Studies*, 34, 103-119.

Jin, H.J., W.W. Koo, and B. Sul (2006), "The Effects of the Free Trade Agreement Among China, Japan, and South Korea," *Journal of Economic Development*, 31, 55-72.

Johansen, S., and K. Juselius (1990), "Maximum Likelihood Estimation and Inference on Cointegration: With Applications to the Demand for Money," *Oxford Bulletin of Economics and Statistics*, 52(2), 169-210.

Kenen, P.B., and D. Rodrik (1986), "Measuring and Analyzing the Effects of Short-Term Volatility in Real Exchange Rates," *The Review of Economics and Statistics*, 68, 311-315.

Klein, M. (1990), "Sectoral Effects of Exchange Rate Volatility on United States Exports," *Journal of International Money and Finance*, 9, 299-308.

McKenzie, M.D. (1999), "The Impact of Exchange Rate Volatility on International Trade Flows," *Journal of Economic Surveys*, 13,71-104.

Mehanna, R.-A., and H. Shamsub (2002), "Why is Benefitting the most from NAFTA? An Intervention Time Series Analysis," *Journal of Economic Development*, 27, 69-79.

Narayan, P.K. (2005), "The Saving and Investment Nexus for China: Evidence from Cointegration Tests," *Applied Economics*, 37, 1979-1990.

Narayan, P.K., S. Narayan, B.C. Prasad, and A. Prasad (2007), "Export-led Growth Hypothesis: Evidence from Papua New Guinea and Fiji," *Journal of Economic Studies*, 34, 341-351.

Ozturk, I., and H. Kalyoncu (2009), "Exchange Rate Volatility and Trade: An Empirical Study from Cross-Country Comparison," *African Development Review*, 21(3), 499-513.

Pesaran, M.H., Y. Shin, and R.J. Smith (2001), "Bounds Testing Approaches to the Analysis of Level Relationships," *Journal of Applied Econometrics*, 16, 289-326.

Poon, W., C. Choong, and M. Habibullah (2005), "Exchange Rate Volatility and Export for Selected East Asian Countries: Evidence from Error-Correction Model," *ASEAN Economic Bulletin*, 22(2), 144-159.

Sercu, P. (1992), "Exchange Risk, Exposure, and the Option to Trade," *Journal of International Money and Finance*, 11, 579-593.

Sercu, P., and C. Vanhulle (1992), "Exchange Rate Volatility, International Trade, and the Value of Exporting Firms," *Journal of Banking and Finance*, 16, 155-182.

Tang, T.C. (2007), "Money Demand Function for Southeast Asian Countries: An Empirical View from Expenditure Components," *Journal of Economic Studies*, 34, 476-496.

Viaene, J.-M., and C.G. de Vries (1989), "International Trade and Exchange Rate Volatility," *European Economic Review*, 36, 1311-1322.

Weliwita, A., and H. Tsujii (2000), "The Exchange Rate and Seri Lanka's Trade Deficit," *Journal of Economic Development*, 25, 131-157.

Wong, K.N., and T.C. Tang (2008), "The Effects of Exchange Rate Variablity on Malaysia's Disaggregated Electrical Exports," *Journal of Economic Studies*, 35, 154-169.

Mailing Address: Mohsen Bahmani-Oskooee, Center for Research on International Economics and The Department of Economics, University of Wisconsin-Milwaukee, Milwaukee, WI 53201, USA. Tel: 414-229-4334. Fax: 414-229-2438. E-mail: bahmani@uwm.edu.

Received August 31, 2010, Revised August 16, 2011, Accepted September 27, 2011.