Journal of Agricultural and Applied Economics, 40,3(December 2008):953–965

Growing U.S. Trade Deficit in Consumer-Oriented Agricultural Products

Renan Zhuang, Won W. Koo, and Jeremy Mattson

We investigate the factors behind the growing U.S. trade deficit in consumer-oriented agricultural products by using reliable panel data and an empirical trade model derived from international trade theory. The results indicate that per capita income in the United States appears to be the most important determinant for the growing U.S. trade deficit of consumer-oriented agricultural products. An increase in per capita income and trade liberalization in foreign countries would improve the U.S. trade balance. U.S. foreign direct investment abroad in food manufactures and the North American Free Trade Agreement (NAFTA) are found to have negative effects on the U.S. trade balance.

Key Words: consumer-oriented products, exchange rate, trade balance, trade deficit

JEL Classifications: F14, Q17

According to the U.S. Department of Agriculture (USDA), U.S. agricultural trade has increased steadily over time, jumping from $61.91 billion (U.S. dollars) in 1989 to $122.50 billion in 2005, an average annual increase of 4.36%. However, U.S. agricultural exports have fluctuated and increased slowly over the past decade, while imports have increased rapidly. As a result, the U.S. trade surplus has declined from $26.91 billion in 1996 to just $3.86 billion in 2005.

The USDA classifies traded agricultural products into bulk, intermediate, and consumer-oriented products. Bulk agricultural products include commodities that have received little or no processing such as wheat, corn, soybeans, and cotton. Intermediate agricultural products are those that have received some processing but are generally not ready for final consumption. These include products such as wheat flour, soybean meal, live animals, and hides and skins. Consumer-oriented agricultural products are those that are generally ready for final consumption, such as snack foods, meat and dairy products, processed or fresh fruits and vegetables, beverages, and other processed or ready-to-eat foods (see Appendix 1 for details).

Comparisons between U.S. trade situations by group provide the following two insights. First, the importance of consumer-oriented agricultural products in U.S. total agricultural trade has increased over time. Specifically, the share of consumer-oriented agricultural products in U.S. total agricultural trade has increased from 34% in 1989 to 55% in 2005

Renan Zhuang is director of economic analysis, USA Poultry and Egg Export Council, Stone Mountain, GA. Won W. Koo is chamber of commerce distinguished professor and director, Center for Agricultural Policy and Trade Studies, Department of Agribusiness and Applied Economics, North Dakota State University, Fargo, ND. Jeremy Mattson is research associate, Upper Plains Transportation Research Institute, North Dakota State University, Fargo, ND.

The authors are grateful to the reviewers' comments and the editor's assistance in improving this article. Any remaining errors and omissions are the sole responsibility of the authors.

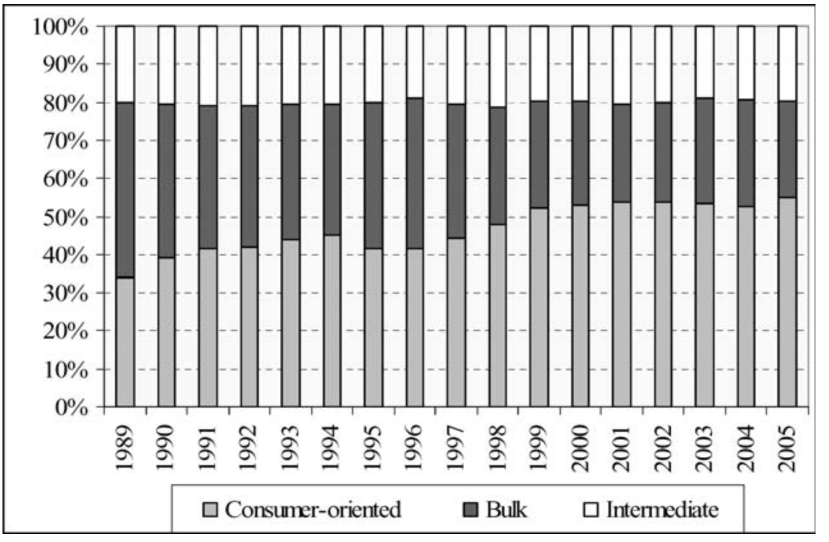

Figure 1. Share of Each Product Group in U.S. Agricultural Trade, 1989–2005 Note: USDA classifies traded agricultural products into bulk, intermediate, and consumer-oriented products. Bulk agricultural products include commodities that have received little or no processing, such as wheat, corn, soybeans, and cotton. Intermediate products are those that have received some processing but are generally not ready for final consumption. These include products such as wheat flour, soybean meal, live animals, and hides and skins. Consumer-oriented products are those that are generally ready for final consumption, such as snack foods, meat and dairy products, processed or fresh fruits and vegetables, beverages, and other processed or ready-to-eat foods.

(Figure 1). By contrast, the share of bulk agricultural products has decreased from 46% in 1989 to 25% in 2005. The share of intermediate agricultural products during this period has been around 20%. Second, the decline in the U.S. total agricultural trade surplus is mainly due to the increase in the trade deficit for consumer-oriented agricultural products. Figure 2 shows the changes in the trade balances for consumer-oriented, bulk, and intermediate agricultural products. The U.S. trade surplus for bulk agricultural products has fluctuated around $15.08 billion with a standard deviation of $2.68 billion. The U.S. trade surplus for intermediate agricultural products was around $4.60 billion prior to 2002 and decreased to $1.21 billion in 2005. By contrast, the U.S. trade balance for consumer-oriented agricultural products has declined sharply from a trade surplus of $2.38 billion in 1995 to a trade deficit of $12.73 billion in 2005.

What are the reasons behind the rapid increase in U.S. trade deficit for consumer-oriented agricultural products? So far, there are essentially no studies in the existing literature that have looked at this critical issue. The objective of this study is to identify the determinants for U.S. trade of consumer-oriented agricultural products, using an empirical trade model derived from international trade theory.

The paper is organized as follows. Section two provides an overview of the changes in exports and imports of consumer-oriented agricultural and food products since 1989.[1] Section three derives an empirical model used for this study. Section four discusses data and estimation method. Section five presents estimation results and discusses our findings. The final section presents conclusions of the paper.

An Overview of U.S. Trade for Consumer-Oriented Products

As shown in Figure 3, U.S. trade for consumer-oriented agricultural products increased

[1] Data are not available prior to 1989.

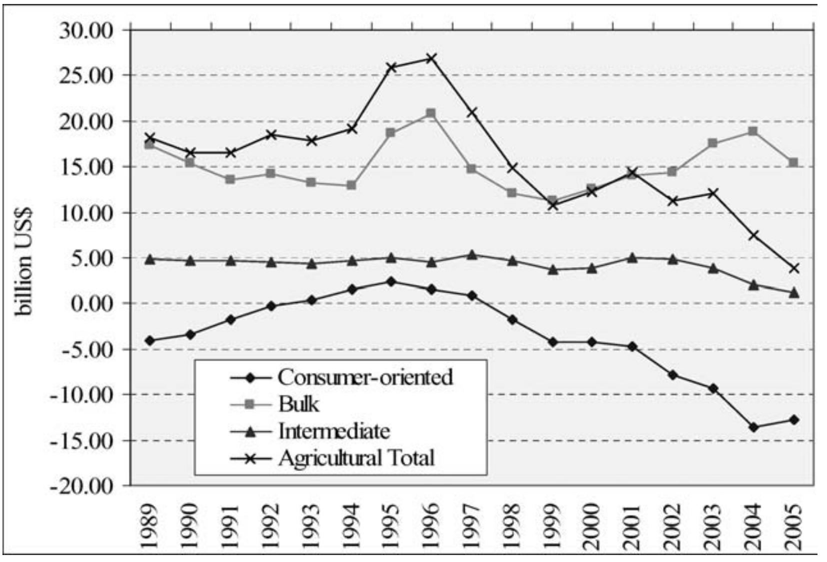

Figure 2. U.S. Trade Balance by Group, 1989–2005 Note: USDA classifies traded agricultural products into bulk, intermediate, and consumer-oriented products. Bulk agricultural products include commodities that have received little or no processing, such as wheat, corn, soybeans, and cotton. Intermediate products are those that have received some processing but are generally not ready for final consumption. These include products such as wheat flour, soybean meal, live animals, and hides and skins. Consumer-oriented products are those that are generally ready for final consumption, such as snack foods, meat and dairy products, processed or fresh fruits and vegetables, beverages, and other processed or ready-to-eat foods.

from $21.14 billion in 1989 to $67.42 billion in 2005, which gave an average annual increase of 7.52%. Trade has increased at an even faster pace since 2002. While U.S. exports of consumer-oriented agricultural products were increasing at a significant pace prior to 1995, from $8.54 billion in 1989 to $19.06 billion in 1995, an average annual increase of 14.32%, U.S. imports of consumer-oriented agricultural products prior to 1995 were increasing at a relatively slower pace, from $12.61 billion to $16.68 billion for the same period, an average annual increase of 4.78%. As a result, the U.S. trade balance for consumer-oriented agricultural products improved from a deficit of $4.07 billion in 1989 to a surplus of $2.38 billion in 1995. After 1995, imports grew at a faster rate than exports. From 1995 to 2005, U.S. imports of consumer-oriented agricultural products increased from $16.68 billion to $40.07 billion, an average annual increase of 9.16%. Exports, however, increased from $19.06 billion in 1995 to $27.35 billion in 2005, an average annual increase of 3.68%. Consequently, the U.S. trade surplus became a deficit again in 1998, and this deficit grew to $13.55 billion in 2004. In ten years, the U.S. trade balance deteriorated by $15.93 billion. This deficit improved slightly to $12.73 billion in 2005.

Canada and Mexico are the most important countries for U.S. imports of consumer-oriented agricultural products. Partly thanks to the North American Free Trade Agreement (NAFTA), which came into effect on January 1, 1994, U.S. imports from these two countries increased from $2.86 billion in 1989 (accounting for 22.7% of U.S. total imports) to $15.82 billion in 2005 (accounting for 39.5% of U.S. total imports). U.S. imports have also increased rapidly from other important trading partners, including Australia, China, some of the European Union (EU) member countries (e.g., Belgium, France, Italy, the Netherlands, and the United Kingdom), and some Latin American countries (e.g., Chile, Colombia,

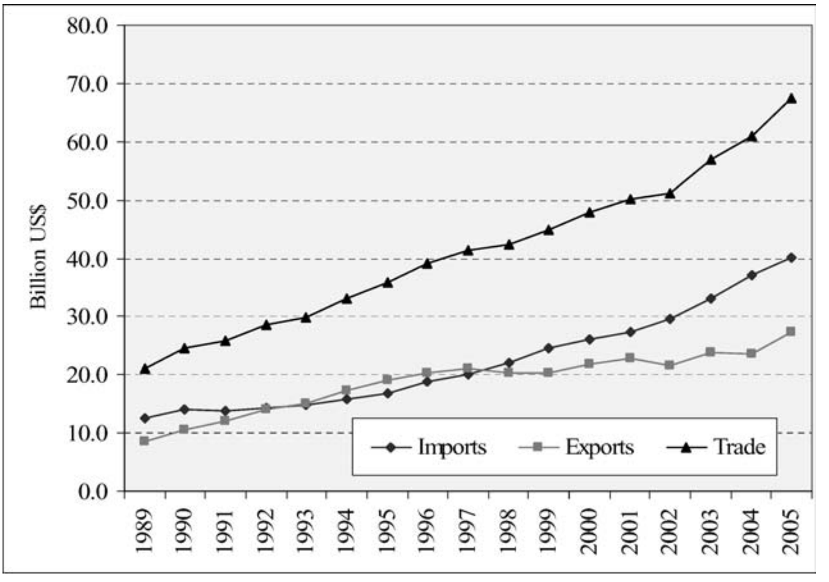

Figure 3. U.S. Trade for Consumer-Oriented Agricultural Products, 1989–2005

Costa Rica, and Ecuador). U.S. imports from Australia (the third most important country after Canada and Mexico) increased from $0.77 billion in 1989 to $2.25 billion in 2005, an average annual increase of 6.89%. Imports from China jumped from $0.16 billion in 1989 to $1.19 billion in 2005, an average annual increase of 13.26%.

U.S. exports to Canada and Mexico, combined, increased from $2.02 billion in 1989 (accounting for 23.7% of U.S. total exports) to $12.33 billion in 2005 (accounting for 45.09% of U.S. total exports). Japan was the single largest market for U.S. exports of consumer-oriented agricultural products in 1989. U.S. exports to Japan in 1989 accounted for 35.08% of its total export, but this share dropped to 12.11% in 2005. Exports to Japan grew at a significant pace, from $2.99 billion in 1989 to $5.36 billion in 1995, but U.S. exports to the country have since declined to $4.50 billion in 1998 (partly due to the Asian financial crisis in 1997–1998), and to $3.31 billion in 2005. The rapid decrease in U.S. exports to Japan in recent years is due in large part to the reported occurrence of mad cow disease in the state of Washington in December 2003, which led to Japan banning imports of U.S. beef. Red meats have been a leading export product for the United States, particularly to Japan. Other important markets for U.S. consumer-oriented exports include South Korea, China, Philippines, and the EU member countries, including Belgium, France, Germany, Spain, the Netherlands, and the United Kingdom.

The primary types of consumer-oriented agricultural products imported and exported by the United States differ across countries. For instance, while the leading U.S. imports from the EU member countries are wine and beer, those from Canada are snack foods and red meats, and those from Mexico are fresh vegetables. By contrast, leading U.S. exports to the EU member countries are nuts, those to Canada are fresh or processed fruits and vegetables and snack foods, and those to Mexico and Japan are red meats.

Empirical Model

According to international trade theory, bilateral trade of a good is mainly influenced by the difference in prices of the good and bilateral exchange rate (Dixit and Norman; Gandolfo). Based on this notion, we specified a bilateral trade model of consumer-oriented products between the United States and its trading partners as a function of differences in the average prices of consumer-oriented products between the United States and its trading partners, bilateral exchange rate, and a vector of other variables as follows:

$$(1)\quad Q_t^{ex} = \alpha_0 + \alpha\left(P_t^f - P_t^{us}\right) + \beta RE_t^{us,f} + \sum_i \lambda_i \boldsymbol{Z}_t + \sum_j \gamma_j \boldsymbol{D}_t + \varepsilon_t,$$

where Q_t^{ex} is U.S. exports to foreign country in time t, P_t^f and P_t^{us} are average prices of consumer-oriented agricultural and food products in the foreign country and the United States, respectively; $RE_t^{us,f}$ is the real exchange rate between the United States and the foreign country (foreign currency per U.S. dollar); $\mathbf{Z}_t$ is a vector of other independent variables that may affect bilateral trade between the United States and foreign country; $\mathbf{D}_t$ is a vector of dummy variables; and ε_t is a random error term.

Other independent variables ($\mathbf{Z}_t$) may include consumer income, market openness, foreign direct investment (FDI), and a demographic variable that reflects the change of consumer tastes and preferences. As consumer income increases, demand for imports of high-value food products increases. Market openness is another factor that potentially affects U.S. trade for consumer-oriented products. In particular, tariff and nontariff trade barriers for consumer-oriented products are significant in most countries (Regmi et al.). It is hypothesized that a more open foreign market would improve U.S. trade balance for consumer-oriented products. The relationship between FDI and trade is subject to much debate. While many have argued that FDI and trade are complements (e.g., Banerjee; Bolling, Neff, and Handy; Koo and Uhm), implying that an increase of U.S. FDI in a foreign country would result in an increase of U.S exports to that country, others have argued that FDI and trade are substitutes (e.g., Gopinath, Pick, and Vasavada), implying that an increase of U.S. FDI in a foreign country would result in a decrease of U.S exports to that country. Some economists (e.g., Malanoski, Handy, and Henderson; Munirathinam, Marchant, and Reed; Overend, Connor, and Salin; Somwaru and Bolling) argue that the FDI-export relationship can be either a complement or substitute relationship depending on factors such as the state of economic development of the host country and the nature of the industry to which the FDI is directed. Demographics may also play a role in the demand for imports. According to the U.S. Census Bureau, the share of foreign-born population in the United States has increased from 7.95% in 1990 to 12.04% in 2005. An increase in foreign-born population could increase U.S. import demand for consumer-oriented goods, since these consumers may have preferences for food products from their home countries.

Four dummy variables are included in this study. The first dummy variable, D^{NAFTA}, is added to account for the effect of NAFTA; the second dummy variable, D^{afc}, is included to account for the impact of the Asian financial crisis in 1997–1999; the third dummy variable, D^{dev}, is added to account for the difference between developed and developing countries; and the fourth dummy variable, D^{Bel}, is added to account for the specific effects of Belgium, since Belgium is an important transshipment point for Europe. In general, developing countries have higher tariffs on consumer-oriented foods than do developed countries. In addition, because of food safety and quality concerns, consumers in the United States may prefer foods imported from developed countries to those from developing countries.

Annual time-series data on average prices of consumer-oriented products are not available in most foreign countries. Following Koo and Zhuang, we use the bilateral trade value of consumer-oriented products (TV_t) between the United States and the foreign country as a proxy for the difference in prices. An increase in price difference between the United States and its trading partners would raise trade value between them, and vice versa. Thus, Equation (1) is rewritten as follows:

$$(2)\quad Q_t^{ex} = \alpha_0 + \alpha TV_t + \beta RE_t^{us,f} + \sum_i \lambda_i \boldsymbol{Z}_t + \sum_j \gamma_j \boldsymbol{D}_t + \varepsilon_t.$$

Since we are interested in modeling U.S. trade balance rather than its exports only, we may use either an export to import ratio or U.S.

export share (Q_t^{ex}/TV_t) as a dependent variable. In this study, we use export share instead of an export to import ratio based on the following reasons: (1) the export share ranges between zero and one and can be transformed into a logarithm form without any concern of possible negative values for the actual trade balance; and (2) the export share variable is less susceptible to extreme observations and is defined even if there is only one-way trade from the United States to its trading partners. Note that the ratio of exports to imports (a traditional indirect measure of trade balance) is not defined in this case.

If we replace $\mathbf{Z}_t$ with per capita income in the United States (Y^{us}); per capita income in the foreign country (Y^{f}); market openness in the foreign country (OP), which is the ratio of total trade value to gross domestic product (GDP); U.S. FDI in the foreign country (FDI_f^{us}); demographic change in the United States ($DEMO$); and if we replace $\mathbf{D}_t$ with the four dummy variables discussed earlier; and assuming the model to be a log-linear equation, the empirical model (Equation [2]) becomes as follows:

$$\begin{aligned} \ln\left(\frac{Q_t^{ex}}{TV_t}\right) &= \alpha_0 + \alpha ln(TV_t) + \beta ln\left(RE_t^{us,f}\right) \\ &+ \lambda_1 ln(Y^{us}) + \lambda_2 ln(Y^f) \\ &+ \lambda_3 ln(OP) + \gamma_4 ln\left(FDI_f^{us}\right) \\ &+ \lambda_5 ln(DEMO) + \gamma_1 D^{NAFTA} \\ &+ \gamma_2 D^{afc} + \gamma_3 D^{dev} + \gamma_4 D^{Bel} + \varepsilon_t. \end{aligned} \tag{3}$$

The sign for α can be either positive or negative. If $\alpha > 0$, the U.S. trade balance improves with increased bilateral trade value. If $\alpha < 0$, the U.S. trade balance deteriorates with increased bilateral trade value. The sign for β is expected to be negative. The real exchange rate ($RE_t^{us,f}$) represents local currency per U.S. dollar. An increase in the real exchange rate means the depreciation of foreign currency relative to the U.S. dollar and thus disfavors U.S. exports to the foreign country. The sign for λ_1 is expected to be negative. An increase in U.S. per capita income would increase demand for imports and thus deteriorate the U.S. trade balance. The sign for λ_2 is expected to be positive. An increase in per capita income in the foreign country would lead the country to import more of U.S. products and thus improve U.S. trade balance. The sign for λ_3 is expected to be positive, since the openness of foreign market is conducive to U.S. exports. The sign for λ_4 is inconclusive since the relationship between FDI and trade is ambiguous, as we discussed earlier. The sign for λ_5 is expected to be negative, since an increase of foreign born population may lead the United States to import more and thus deteriorate the U.S. trade balance. The sign for γ_1 is expected to be negative. While both U.S. exports and imports have increased under NAFTA, imports have grown at a faster pace than exports. The sign for γ_2 is expected to be negative, since the Asian financial crisis decreased U.S. exports to Asian countries. The sign for γ_3 is expected to be negative since U.S. imports from the developed countries have increased faster than those from developing countries. The sign for γ_4 is expected to be positive since Belgium is an important transshipment point for Europe, and U.S. exports to Belgium have increased more rapidly than those to other countries.

Note that the bilateral trade volume variable, TV_t, in Equation (3) is potentially correlated with the error term, since it is a component of the dependent variable. The variable, FDI_f^{us}, in the equation may be endogenous as well. A firm's decision to invest in another country may be influenced by many factors, such as the host country market size and economic stability in the host country. The endogeneity issue associated with the two variables will be further discussed in the next section.

Data and Estimation Method

We use a panel data set covering a 17-year period, from 1989 to 2005, and 28 countries, based on data availability. The 28 countries include Argentina, Australia, Belgium, Brazil, Canada, Chile, China (mainland), Colombia, Costa Rica, Dominican Republic, Ecuador, France, Germany, India, Indonesia, Ireland, Italy, Japan, Korea, Mexico, Netherlands, Panama, Peru, Philippines, Spain, Thailand, United Kingdom, and Venezuela. These countries are major trading U.S. partners, accounting for 81.4% of U.S total trade volume in consumer-oriented products on the average during the period from 1989 to 2005.

Annual time-series data for U.S. exports to and imports from foreign countries for consumer-oriented products were obtained from the USDA Foreign Agricultural Service (FAS) online database. These data are expressed in dollar terms instead of quantity terms because they measure the trade in an aggregate group of commodities. Annual time-series data for FDI for the food industry were obtained from the U.S. Department of Commerce's Bureau of Economic Analysis (BEA). The BEA data measures FDI as sales by affiliates and as the investment position on a historical cost basis. Note that the industry classifications were based on the Standard Industrial Classification (SIC) codes prior to 1999, while they have changed to the North American Industry Classification System (NAICS) beginning in 1999. This change of industry classification may have reduced slightly the magnitude of FDI reported in the food industry after 1999 because the definition of food industry under NAICS is relatively narrower than that under SIC. The annual time-series data for real exchange rate (in terms of foreign currency per U.S. dollar) were obtained from the USDA's Economic Research Service (ERS) online database. Annual time-series data for real per capita income (purchasing power parity adjusted real per capita GDP), consumer price index (CPI), population, total trade, and total GDP were obtained from the World Bank's World Development Indicators (WDI) online database. The summary statistics of the panel data set are presented in Appendix 2.

Several potential econometric problems were addressed before estimation. First, nonstationarity of the data may lead to spurious estimation results (Entorf). We evaluated the stationarity properties of the variables using both Pesaran and Levin, Lin, and Chu panel unit root test methods. The test results are summarized in Table 1. All the variables under test were found to be stationary using both test methods.

Second, the variables TV_t and FDI_f^{us} in Equation (3) may be endogenous, as we discussed earlier. A firm's decision to invest in another country may be influenced by many factors, such as the host country market size and economic stability. To test the exogeneity of the above two variables, we used the Davidson-Mackinnon test.[2] The null hypotheses, which state that an OLS fixed effect model would result in consistent estimates, are rejected at a 1% level for both cases (Table 1), indicating that TV_t and FDI_f^{us} are endogenous variables.

The endogeneity problems for these two variables are addressed through an instrumental variables estimation approach. For the bilateral trade volume variable, TV_t, the instrumental variables include the exogenous variables in Equation (3) and three other variables. The first instrumental variable is the natural logarithm of the sum of real gross domestic products of the United States and the foreign country (ln *TGDP*). According to Glick and Rose and Rose and Wincoop, the sum of income between two trading countries is strongly correlated with trade volume between the countries, but it has no effects on the export share of a specific country. The second and the third instrumental variables are the natural logarithm of the U.S. consumer price index (ln *UScpi*) and the natural logarithm of the foreign consumer price index (ln *Fcpi*). Koo and Zhuang found that the natural logarithms of the consumer price indices in the home and foreign countries are strongly correlated with the natural logarithm of the bilateral trade volume, while their correlations with export share of a specific country are very small. For U.S. FDI abroad, the instrumental variables include per capita GDP, real exchange rate

[2] Davidson and MacKinnon show that this test, which is similar to the Durbin-Wu-Hausman test, will always yield a computable test statistic, whereas the Hausman test, depending on the difference of estimated covariance matrices being a positive definite matrix, often cannot be computed by standard matrix inverse methods.

Table 1. Results of Panel Unit Root Tests and Other Tests

Variable	Levin-Lin-Chu Method	Pesaran Method
U.S. Exports Share, ln(Share)	-4.684^{***} (0.000)	-2.119^{**} (0.025)
Bilateral Trade Volume, $\ln(TV_t)$	-2.525^{***} (0.006)	-2.066^{**} (0.045)
Real Exchange Rate, $\ln\left(RE_t^{us,f}\right)$	-6.889^{***} (0.000)	-2.738^{***} (0.000)
U.S. Per Capita Income, $\ln(Y^{us})$	na	na
Foreign Per Capita Income, $\ln(Y^f)$	-2.853^{***} (0.002)	-2.598^{***} (0.000)
Foreign Market Openness, $\ln(OP)$	-20.89^{***} (0.000)	-3.898^{***} (0.000)
Foreign Direct Investment, $\ln\left(FDI_f^{us}\right)$	-7.261^{***} (0.000)	-2.378^{***} (0.000)
U.S. Demographic Change, $\ln(DEMO)$	na	na

Davidson-MacKinnon test of exogeneity for $\ln\left(FDI_f^{us}\right)$: F(1, 440) = 69.14 (0.000)
Davidson-MacKinnon test of exogeneity for $\ln(TV_t)$: F(1, 440) = 69.14 (0.000)
Wooldridge test for serial correlation: F(1, 27) = 39.02 (0.000)
Likelihood-ratio test for heteroskedasticity: LR χ^2 (27) = 468.5 (0.000)

Note: Reported values include the *t*-bar statistic and the probability of the null hypothesis that the variable has unit root (in parenthesis). Panel unit root tests are irrelevant for U.S. per capita income and demographic change, since there are no variations across the panels for these two variables. Asterisks *** and ** represent significance level at 1% and 5%, respectively. Tests were conducted in the presence of a constant only. The cases with a constant and a time trend are irrelevant for our study, since no trend variables are included in our model.

volatility,[3] foreign consumer price index, and foreign market openness. While per capita GDP is a proxy for market size, real exchange rate volatility and foreign consumer price index reflect the economic stability of a country.

Finally, there are potential problems of heteroskedasticity and serial correlation, which are common symptoms for panel data sets. We performed a likelihood-ratio test for heteroskedasticity. The null hypothesis is rejected at a 1% level, indicating the symptom of heteroskedasticity (Table 1). We also tested for serial correlation using the test for panel data derived by Wooldridge. Drukker has demonstrated that this test is attractive because it can be applied under general conditions and is easy to implement. The null hypothesis of no serial correlation is rejected at a 1% level, indicating the symptom of serial correlation. To tackle these problems in our estimation, we use the generalized least squares (GLS) estimation method to estimate our model. It is assumed that the error structure across the panels is heteroskedastic and that serial correlation across time is a panel-specific autoregressive process of order one.

Results and Discussion

The estimation results are summarized in Table 2. All the estimated parameters have the expected signs, and most estimated coefficients are statistically significant at either the 1% or 5% level. Specifically, the estimated coefficient for the bilateral trade value variable, $\ln(TV_t)$, is 0.388 and statistically significant at a 1% level. This implies that a 1% increase in U.S. bilateral trade value with its trading partners (TV_t), *ceteris paribus*, would increase U.S. export share by 0.388%. In other words, the U.S. trade balance for consumer-oriented agricultural products would improve if U.S. bilateral trade value with other countries increases. While U.S. export share has decreased with the increase of bilateral trade in the cases of Canada and Mexico, as discussed earlier, U.S. export share has increased with the increase of bilateral trade in the cases of China, India, and most other countries. Since each U.S. trading partner is equally weighted in our regression, an increase

[3] Exchange rate volatility is measured as the deviation from the three-year mean in absolute percentage terms.

Table 2. Generalized Least Squares (GLS) Estimation Results

Parameters	Independent Variables	Estimates
α	Bilateral trade volume, $\ln(TV_t)$	0.388*** (0.043)
β	Real exchange rate, $\ln\left(RE_t^{us,f}\right)$	−0.091** (0.038)
λ_1	U.S. per capita income, $\ln(Y^{us})$	−1.414*** (0.359)
λ_2	Foreign per capita income, $\ln(Y^f)$	0.481*** (0.157)
λ_3	Foreign market openness, $\ln(OP)$	0.030*** (0.007)
γ_4	Foreign direct investment, $\ln\left(FDI_f^{us}\right)$	−0.151*** (0.035)
λ_5	U.S. demographic change $\ln(DEMO)$	−0.027 (0.173)
γ_1	Dummy for NAFTA	−0.243*** (0.076)
γ_2	Dummy for Asian financial crisis	−0.006 (0.019)
γ_3	Dummy for developed countries	−0.667*** (0.232)
γ_4	Dummy for Belgium	0.944*** (0.084)
α_0	Intercept	7.599*** (2.674)
	Number of observations	476

Note: Dependent variable is U.S. export share. Standard errors are in parentheses. Asterisks *** and ** represent significance level at 1% and 5%, respectively.

in U.S. bilateral trade with its trading partners would, on the average, lead to an increase in U.S. export share in consumer-oriented agricultural products.

The estimated coefficient for the bilateral exchange rate, $\ln\left(RE_t^{us,f}\right)$, is −0.091 and statistically significant at a 5% level. It means that a 1% increase of the exchange rate (i.e., U.S. dollar appreciates by 1% against foreign currencies), all other things being equal, would lead to a decrease of 0.091% in export share held by the United States. Appreciating the U.S. dollar against foreign currencies would make the U.S. products more expensive relative to the corresponding foreign products. Thus, it would lead to an increase in U.S. imports and a decrease in U.S. exports, resulting in a decrease in U.S. export share. Similarly, depreciation of the U.S. dollar leads to an increase in U.S. export share.

The estimated parameter for U.S. per capita income is −1.414 and is statistically significant at a 1% level, implying that a 1% increase of U.S. per capita income, *ceteris paribus*, would decrease U.S. export share by 1.414%. This reflects that as per capita income increases in the United States, U.S. imports of consumer-oriented agricultural products increase faster than U.S. exports. The estimated parameter for per capita income in foreign countries is 0.481 and is statistically significant at a 1% level, indicating that a 1% increase of foreign per capita income, all other things being equal, would lead to an increase of 0.481% of export share held by the United States. In other words, as per capita income increases in foreign countries, their imports of consumer-oriented agricultural products from the United States will grow faster than their exports. Furthermore, it is worth noting that U.S. export share is much more sensitive to its income than foreign income.

The estimated parameter for foreign market openness is 0.030 and is statistically significant at a 1% level. This indicates that an open market of U.S. trading partners would have a positive impact on U.S. trade balance for consumer-oriented agricultural products. The estimated coefficient for the U.S. FDI variable is −0.151 and is statistically significant at a 1% level. This implies that a 1% increase of U.S. foreign direct investment in the foreign countries would lead to a decrease of 0.15% in U.S. export share of consumer-oriented agricultural products. This result suggests that FDI and exports of consumer-oriented agricultural products have a substitute relationship, which is consistent with the findings by Gopinath, Pick, and Vasavada. The estimated coefficient for the

U.S. demographic variable (*DEMO*) is −0.027, which has the expected negative sign but is not statistically significant.

The estimated parameter for the NAFTA dummy variable is −0.243 and is statistically significant at a 1% level. This suggests that NAFTA has a significant negative impact on the U.S. trade balance for consumer-oriented agricultural products, leading to a decrease of 21.6% in U.S. export share to Canada and Mexico. The estimated coefficient for the dummy variable for the Asian financial crisis is −0.006, which has the expected negative sign but is not statistically significant. The estimated coefficient for the dummy variable of developed countries is −0.667 and is statistically significant at a 1% level. This result indicates that U.S. export shares in developed countries have tended to be lower than those in developing countries. Therefore, the United States should promote its trade with developing countries to improve its trade deficit in consumer-oriented agricultural products. The estimated parameter for the dummy variable of Belgium is 0.944 and is statistically significant at a 1% level. This result suggests that U.S. export share is much higher in Belgium than other countries, which is likely due to Belgium being an important transshipment point for Europe.

Summary and Conclusions

The U.S. agricultural trade surplus has declined significantly from $26.91 billion in 1996 to just $3.86 billion in 2005. Much of the decline is due to the rapid increase in the U.S. trade deficit for consumer-oriented agricultural products. So far, to the best of our knowledge, there are essentially no studies in the existing literature that have looked at this critical issue for U.S. agricultural trade. In this study, we have investigated the determinants behind the growing U.S. trade deficit in consumer-oriented agricultural products, using a panel data set covering 28 countries and a time period of 17 years from 1989 to 2005. An empirical trade model was derived based on international trade theory. The generalized least squares estimator was used to estimate the parameters of the model, and the endogeneity problem associated with bilateral trade volume and foreign direct investment were corrected through an instrumental variables estimation approach.

The estimated parameters have expected signs for all variables, and most are statistically significant at a 1% or 5% level. Per capita income in the United States appears to be the most important determinant of U.S. trade balance of consumer-oriented products. A 1% increase of U.S. consumer income, *ceteris paribus*, would decrease U.S. export share by 1.414%. The results also suggest that an increase in per capita income and trade liberalization in foreign countries would improve U.S. trade balance in consumer-oriented agricultural products.

U.S. FDI abroad in food manufactures has increased in recent years, and this is found to have a negative effect on U.S. trade balance in consumer-oriented agricultural products. U.S. multinationals in the processed food industry tend to move capital investment into foreign countries to produce consumer-oriented final goods and market them in the countries directly rather than shipping from the United States. These results suggest that offshore business movement by the U.S. companies would hurt the U.S. trade balance.

The results suggest that NAFTA has deteriorated the U.S. trade balance of consumer-oriented agricultural products. U.S. imports from Canada and Mexico have increased faster than its exports to the two countries under NAFTA. The trade pattern is based on differences in prices of highly substitutable products and differences in resource endowments. In addition, the value of the U.S. dollar plays an important role in trade of consumer-oriented agricultural products. The recent continuous depreciation of the U.S. dollar would have a positive effect on the U.S. trade balance of consumer-oriented products.

[Received May 2007; Accepted February 2008.]

References

Banerjee, N. *Recent Trends in Foreign Direct Investment: A Comparison of Canada with the USA and Mexico*. Ottawa, Canada: The Department of Foreign Affairs and International

Trade, Trade and Economic Analysis Division, 1997.

Bolling, C., S. Neff, and C. Handy. *U.S. Foreign Direct Investment in the Western Hemisphere Processed Food Industry.* Agricultural Economic Report No. 760. Washington, D.C.: U.S. Department of Agriculture, Economic Research Service, March 1998.

Davidson, R., and J.G. MacKinnon. *Estimation and Inference in Econometrics*. New York: Oxford University Press, 1993.

Dixit, A., and V. Norman. *Theory of International Trade: A Dual, General Equilibrium Approach*. Cambridge University Press, 1980.

Drukker, D.M. "Testing for Serial Correlation in Linear Panel-Data Models." *The Stata Journal* 3(2003):168–77.

Entorf, H. "Random Walks with Drifts: Nonsense Regression and Spurious Fixed-Effect Estimation." *Journal of Econometrics* 80(1997):287–96.

Gandolfo, G. *International Finance and Open-Economy Macroeconomics*. Berlin: Springer-Verlag, 2001.

Glick, R., and A.K. Rose. "Does a Currency Union Affect Trade?" Working Paper No. 8396. National Bureau of Economic Research, Cambridge, Massachusetts, 2001.

Gopinath, M., D. Pick, and U. Vasavada. "The Economics of Foreign Direct Investment and Trade with an Application to the U.S. Food Processing Industry." *American Journal of Agricultural Economics* 81(1999):442–52.

Koo, W.W., and I.H. Uhm. "Economic Analysis of Foreign Direct Investment and Exports: A Case Study of the U.S. Food Manufacturing Industry." *The Journal of World Investment* 4(2001): 791–804.

Koo, W.W., and R. Zhuang. "The Role of Exchange Rate in Sino–U.S. Bilateral Trade." *Contemporary Economic Policy* 25(2007):362–73.

Levin, A., C.F. Lin, and C. Chu. "Unit Root Test in Panel Data: Asymptotic and Finite Sample Properties." *Journal of Econometrics* 108(2002):1–25.

Malanoski, M., C. Handy, and D. Henderson. "Time Dependent Relationships in U.S. Processed Food Trade and Foreign Direct Investment." *Foreign Direct Investment and Processed Food Trade*. NCR–182 Committee and Farm Foundation, published in cooperation with the Department of Agricultural Economics, Oklahoma State University, Stillwater, Oklahoma, March 1997.

Munirathinam, R., M.A. Marchant, and M.R. Reed. "The Canada–U.S. Free Trade Agreement: Competitive Tradeoffs Between Foreign Direct Investment and Trade." *Trade Policy and Competition: Forces Shaping American Agriculture, Proceedings*. Southern Cooperative Series Bulletin 390, Southern Association of Agricultural Experiment Station Directors, Raleigh, NC, 1998.

Overend, C., J.M. Connor, and V. Salin. "Foreign Direct Investment and U.S. Exports of Processed Foods: Complements or Substitutes?" *Foreign Direct Investment and Processed Food Trade*. NCR–182 Committee and Farm Foundation, published in cooperation with the Department of Agricultural Economics, Oklahoma State University, Stillwater, Oklahoma, March 1997.

Pesaran, M. Hashem. "A Simple Panel Unit Root Test in the Presence of Cross Section Dependence." Cambridge Working Papers in Economics 0346, University of Cambridge, Cambridge, UK, October 2003.

Regmi, A., M. Gehlhar, J. Wainio, T. Vollrath, P. Johnston, and N. Kathuria. *Market Access for High-Value Foods.* Agricultural Economic Report No. 840. Washington, D.C.: U.S. Department of Agriculture, Economic Research Service, February 2005.

Rose, A.K., and E. Wincoop. "National Money as a Barrier to International Trade: The Real Case for Currency Union." *American Economic Review* 91(2001):386–390.

Somwaru, A., and C. Bolling. "U.S. Foreign Direct Investment and Trade: Substitutes or Complements? The Case of the Food Processing Industry." Paper presented at the American Agricultural Economics Association Annual Meeting, Nashville, TN, August 1999.

U.S. Census Bureau. *International Data Base*. Internet site: http://www.census.gov/ipc/www/idbnew.html (Accessed December 3, 2006).

U.S. Department of Agriculture, Economic Research Service. *Agricultural Exchange Rate Data Set*. Internet site: http://www.ers.usda.gov/Data/exchangerates/ (Accessed December 10, 2006).

U.S. Department of Agriculture, Foreign Agricultural Service. *FAS Online Database*. Internet site: http://www.fas.usda.gov/USTrade/USTImBICO.asp?QI (Accessed December 7, 2006).

U.S. Department of Commerce, Bureau of Economic Analysis. *Bureau of Economic Analysis*. Internet site: http://www.bea.gov/ (Accessed December 3, 2006).

Wooldridge, J. *Economic Analysis of Cross-Section and Panel Data*. Cambridge, MA: MIT Press, 2002.

World Bank. *World Development Indicators (WDI) Online Database*. Internet site: http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20398986~menuPK:64133163~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html (Accessed on December 9, 2006).

Appendix 1. U.S. Bulk, Intermediate, and Consumer-Oriented Commodity Aggregations

Bulk Agricultural Products	
Wheat	Coarse grains
Rice	Tobacco
Rubber & allied products	Coffee, unroasted
Cocoa beans	Tea and herb
Raw beet and cane sugar	Other bulk commodities
Intermediate Agricultural Products	
Tropical oils	Other vegetable oils
Feed and fodders	Live animals
Hide and skins	Planting seeds
Sugar and sweeteners	Essential oils
Cocoa paste and cocoa butter	Other intermediate products
Consumer-Oriented Agricultural Products	
Snack foods	Red meats (fresh, chilled, and frozen)
Red meats (preparations)	Cheese
Other dairy products	Bananas and plantains
Other fresh fruit	Fresh vegetables
Processed fruit and vegetables	Fruit and vegetable juices
Tree nuts	Wind and beer
Nursery products	Roasted and instant coffee
Spices	Other consumer-oriented

Source: U.S. Department of Agriculture, Foreign Agricultural Service (http://www.fas.usda.gov/USTrade/ustlists/ImBI-COGrp.asp?QI=).

Note: The commodity codes are derived from the Harmonized Tariff System (HTS) to the six-digit level for generalized categories. The U.S. defines products using 10-digit HTS codes. While exports codes are administered by the U.S. Census Bureau, imports codes are administered by the U.S. International Trade Commission.

Appendix 2. Summary Statistics of the Panel Data Set

Variable		Mean	Standard Deviation	Minimum	Maximum	Observations
U.S. export share	overall	0.326	0.262	0.008	0.963	$N = 476$
	between		0.256	0.035	0.945	$n = 28$
	within		0.075	0.024	0.630	$T = 17$
Bilateral trade volume	overall	1,198.5	2,149.7	14.9	16,805.5	$N = 476$
	between		1,966.4	91.0	9,187.7	$n = 28$
	within		940.5	−5120.4	8,816.3	$T = 17$
Real exchange rate	overall	1,047.0	3,505.7	0.55	25,566	$N = 476$
	between		3,501.7	0.62	17,723	$n = 28$
	within		664.4	−1697	8,890	$T = 17$
U.S. per capita income	overall	31,935	2,971	27,990	37,437	$N = 476$
	between		0	31,935	31,935	$n = 28$
	within		2,971	27,990	37,437	$T = 17$
Foreign per capita income	overall	13,346	9,405	1,565	36,621	$N = 476$
	between		9,308	2,207	26,186	$n = 28$
	within		2,176	3,290	25,397	$T = 17$
Foreign market openness	overall	65.6	38.9	13.2	198.8	$N = 476$
	between		37.7	19.4	158.7	$n = 28$
	within		11.9	28.1	113.5	$T = 17$
U.S. FDI abroad	overall	806.3	1,181.7	0.01	9011	$N = 476$
	between		990.5	17.7	3677	$n = 28$
	within		669.7	−970.9	7478	$T = 17$
Share of foreign-born population in USA	overall	9.81	1.43	7.95	12.04	$N = 476$
	between		0	9.81	9.81	$n = 28$
	within		1.43	7.95	12.04	$T = 17$
U.S. consumer price index	overall	92.9	11.9	72.0	113.4	$N = 476$
	between		0	92.9	92.9	$n = 28$
	within		11.9	72.0	113.4	$T = 17$
Foreign consumer price index	overall	86.5	35.1	0.0001	274.5	$N = 476$
	between		10.2	64.0	97.7	$n = 28$
	within		33.6	−9.4	282.6	$T = 17$
Foreign gross domestic products	overall	836.4	1,051.5	10.3	7,667.9	$N = 476$
	between		1,000.3	16.0	4,137.1	$n = 28$
	within		372.5	−1,550.6	4,367.2	$T = 17$

Note: Bilateral trade volume is in million U.S. dollars. Per capita income is in the form of PPP (purchasing power parity) adjusted per capita GDP on the base year 2000. Real exchange rate is in local currency per U.S. dollar. Share of foreign-born population is in percentage.