The Impact of Exchange Rate Volatility on U.S. Poultry Exports

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ABSTRACT
Existing empirical evidence on the effect of exchange rate uncertainty on trade is generally conflicting and inconclusive. While some studies found a positive relationship between exchange rate volatility and trade, others argue for the opposite. Furthermore, the vast majority of past studies only focused on aggregate trade flow data. The lack of extensive literature on studies based on disaggregated and commodity-level data may partially explain the ambiguity in past empirical evidence. This paper re-examines the relationship between exchange rate volatility and U.S. poultry exports using a panel data for 49 importing nations over two subperiods: 1976–1985 and 1986–2000. The analysis uses a fixed-effects model specification and three alternative measures of exchange rate volatility. The empirical results suggest that the choice of volatility measure matters as there is a positive relationship between exchange rate uncertainty and poultry exports. These findings are consistent with those from several previous studies. [JEL classification: F310, Q170]. © 2006 Wiley Periodicals, Inc.

1. INTRODUCTION
In the past three decades, there has been an on-going debate in the theoretical and empirical economics circles on how trade volumes respond to exchange rate volatility (i.e., the risk associated with unanticipated fluctuations in the exchange rate). Central to this debate is the question of whether the high level of exchange rate volatility observed since the breakdown of the fixed exchange rate system in the early 1970s has had a negative effect on international trade. The controversy has been fueled by the ambiguous and conflicting nature of the existing economic theory and empirical evidence. While some authors argue for a negative effect of exchange rate volatility on trade, others advocate a positive relationship (McKenzie, 1999).

Early theoretical analyses have traditionally claimed that increased exchange rate uncertainty should reduce the level of trade. For example, Hooper and Kohlhagen (1978) and...
Cushman (1983) show that exchange rate volatility may have a negative effect on international trade flows. However, more recent studies by Dellas and Zilberfarb (1993) and Viaene and de Vries (1992) provide a theoretical basis for a positive effect of exchange rate variability on trade. Furthermore, DeGrauwe (1988) and Giovannini (1988) present a case where increases in exchange rate volatility do not necessarily lead firms to restrict supply, and where, if export prices are invoiced in domestic currency, expected profits might actually increase as a result of an increase in exchange rate risk, leading firms to reduce their export prices. DeGrauwe (1988) asserts that a very risk-averse exporter who worries about the decline in his or her revenue might export more when risk is high.

It is interesting to note that the vast majority of the past studies examined aggregate trade flow data. Bini-Smaghi (1991) argues that the conflicting empirical evidence on the impact of exchange rate uncertainty on trade may be due partly to the use of aggregated data. This is because the use of aggregate data unnecessarily, and perhaps erroneously, assumes that income, price, and exchange rate elasticity estimates are equal across sectors. If this assumption is incorrect, then the examination of aggregate trade data is likely to dilute the true nature of the relationship and lessen the probability of obtaining accurate empirical results. It is more plausible to assume that the impact of exchange rate volatility will differ across various tradable goods sectors (or commodities).

Similar to the conflicting theoretical views on the role of exchange rate risk, the results from available empirical studies have been mixed and sometimes ambiguous. Several studies found support for the hypothesis of a negative relationship between exchange rate volatility and trade (Arize, 1997; Chowdhury, 1993; Frankel & Wei, 1993; Kenen & Rodrik, 1986; Koray & Lastrapes, 1989). In contrast, other studies found that the risk associated with exchange rate volatility may actually have a positive impact on trade (Bailey, Tavlas, & Ulan, 1986; Gotur, 1985; Hooper & Kohlhagen, 1978). The effect of fluctuations in exchange rate is particularly important for U.S. agriculture because about 20% of U.S. agricultural output is exported to foreign markets. However, there has been relatively little research on the impact of exchange rate risk on agricultural trade. Earlier works on agricultural trade and exchange rates, focused on the impact of changes in the level of real exchange rate on agricultural exports. Examples of these works include Batten and Belongia (1986), Haley and Krissoff (1987), and Bessler and Babula (1987).

Reflecting earlier research in the general literature, empirical studies on short-run exchange rate volatility and agricultural trade flows have produced ambiguous results. For example, Pick (1990) found that exchange rate risk had no effect on U.S. trade flows to other developed countries, though it had a negative effect on U.S. exports to developing countries. In contrast, Klein (1990) found that short-run real exchange rate volatility negatively affected U.S. agricultural exports compared to other sectors. Maskus (1986) also found that the sector most affected by short-run volatility was agriculture. Anderson and Garcia (1989) found that exchange rate volatility had a significantly negative effect on U.S. export of soybeans to three developed countries.

Although some authors have examined the impact of exchange rate volatility on the agricultural sector, most of these analyses depended on the use of highly aggregated data (Batten & Belongia, 1986; Cho, Sheldon, & McCorriston, 2002). A notable exception is a recent book by Langley, Mohanty, Guigale, & Meyer (2002), which consists of short papers that investigated the impact of exchange rate volatility on the export of various agricultural commodities (Canadian pork, Thai poultry and rice, and U.S. and Brazilian soybeans and soy products). They concluded that the effect of exchange rate volatility on exports depends on the nature of the agricultural commodities and other economic factors.
This current study extends these empirical studies at the commodity level by focusing on the relationship between exchange rate volatility and U.S. poultry exports.

This paper focuses on the poultry export market because of its increasingly important role in U.S. meat trade. Given that a significant portion of total poultry production is exported, the U.S. poultry industry is potentially subject to changes in foreign markets’ economic conditions, transmitted via exchange rates fluctuations. In recent years, Asian and Russian market destinations have experienced significant level of economic uncertainty and volatility in prices for poultry meat. This paper contributes to the literature by analyzing the impact of exchange rate volatility on U.S. poultry trade over the period 1976 to 2000. Also, this paper examines a comprehensive list of the top forty-nine importers of U.S. poultry. These 49 importers account for over 85% of the total value of U.S. poultry exports in 2000. In addition to focusing on a particular agricultural commodity, the effect of using alternative measures of exchange rate volatility is also investigated. The rest of the paper is organized as follows. Section two briefly discusses recent trends in the U.S. poultry industry. Sections three and four describe the data set and the econometric model formulation. The fifth section presents the empirical results and the last section offers concluding remarks.

2. U.S. POULTRY EXPORTS TRENDS

Historically, fluctuations in the exchange rate have accounted for approximately 40% of the change in the real value of U.S. agricultural exports (Economic Research Service, USDA). A severe and prolonged financial crisis abroad could substantially lower U.S. agricultural exports earnings. The U.S. poultry industry, the world’s largest producer and exporter of poultry meat, is very dependent on exports to Asia and Russia. In 2003, the U.S. exported over $11.7 billion worth of animal products (excluding live animals) to the rest of the world, of which 51% were shipped to Asian markets. Poultry and poultry products consisted of 25.7% of total Asian imports in animal products from the U.S. Global trade in poultry meat is projected to trend upward to more than 9 million tons by 2007 (Foreign Agricultural Service, USDA). Imports are anticipated to increase in all the largest import markets, including Russia, China, Japan, Hong Kong, Mexico, Canada, and the Middle East. Table 1 contains the relative size of imports for a list of the top 10 poultry importers from the United States. The top five importers (Russia, Mexico, EU, Hong Kong, and China) account for approximately 57% (quantity) and 50% (value), respectively, of total U.S. poultry exports.

Most of the growth in world poultry trade is expected to come from expanded shipments of relatively low-priced poultry parts. Figure 1 shows the annual percent change in U.S. poultry shipments to various regions in the study over 2000–2003. Except for East Asian markets which have experienced negative growth rate, the demand for U.S. poultry exports has been increasing in most other regions of the world (see Figure 1). Increasing competition from low cost poultry producers in Brazil and Thailand may be responsible for the declining trend in the demand for U.S. poultry exports to East Asia. As markets have opened to increased poultry trade, the United States has benefited by selling chicken breasts in the domestic market and exporting dark meat and less valuable cuts to other markets where they are preferred over breast meat. This strategy has been especially beneficial for the United States, as large markets have developed for leg meat in Russia and wings, wing tips, and paws in Hong Kong and China.
Exchange rate uncertainty could have a negative impact on U.S. poultry exporters as it might create pressure on their profit margin. For instance the Asian financial market crisis in 1997 and the Russian poultry meat embargo in 2001 had significant ramifications for poultry exporters. The Asian crisis started with a wave of currency devaluations, stock market plunges, and business failures in several countries across the East Asian region. Exchange rate—the price of a nation’s currency in terms of another nation’s currency—is probably the single most important variable in determining the level of trade. The fluctuations in the real exchange rate result in the rise and fall of the prices of U.S. agricultural products in terms of the local currency in foreign countries. The Asian crisis led to the depreciation of the foreign currencies (appreciation of U.S. dollar). A depreciated currency in Asia raised the price of U.S goods abroad and could consequently reduce the volume of U.S. export sales. Severe and prolonged future financial crisis could substantially lower U.S. agricultural export earnings and shift trade patterns in some Asian countries.

<table>
<thead>
<tr>
<th>Country</th>
<th>Qty (1000 MTs)</th>
<th>% of Total</th>
<th>Value (Million $)</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia</td>
<td>677.40</td>
<td>26.86</td>
<td>380.98</td>
<td>20.75</td>
</tr>
<tr>
<td>Mexico</td>
<td>288.03</td>
<td>11.42</td>
<td>259.54</td>
<td>14.13</td>
</tr>
<tr>
<td>European Union</td>
<td>181.01</td>
<td>7.18</td>
<td>90.54</td>
<td>4.93</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>162.26</td>
<td>6.43</td>
<td>120.64</td>
<td>6.57</td>
</tr>
<tr>
<td>China</td>
<td>136.47</td>
<td>5.41</td>
<td>72.25</td>
<td>3.93</td>
</tr>
<tr>
<td>Canada</td>
<td>116.27</td>
<td>4.61</td>
<td>268.88</td>
<td>14.64</td>
</tr>
<tr>
<td>South Korea</td>
<td>76.92</td>
<td>3.05</td>
<td>49.54</td>
<td>2.70</td>
</tr>
<tr>
<td>Georgia</td>
<td>67.91</td>
<td>2.69</td>
<td>35.54</td>
<td>1.94</td>
</tr>
<tr>
<td>Japan</td>
<td>50.46</td>
<td>2.00</td>
<td>61.24</td>
<td>3.33</td>
</tr>
<tr>
<td>Latvia</td>
<td>44.11</td>
<td>1.75</td>
<td>24.14</td>
<td>1.31</td>
</tr>
<tr>
<td>Estonia</td>
<td>6.08</td>
<td>0.24</td>
<td>3.47</td>
<td>0.19</td>
</tr>
</tbody>
</table>

Source: Foreign Agricultural Service, USDA

Figure 1 U.S. Poultry Export Trends 2000–2003.
3. DATA AND SOURCES

The data on importer GDP, trade openness, and real exchange rate between the United States and 49 of its poultry importing countries were obtained from the Penn World Tables (PWT) 6.1 (Heston, Summers, & Aten, 2002). The real gross domestic product (GDP) per capita variable serves as proxy for importer country income while the trade openness variable serves as proxy for government trade policy and institutional changes over time. Trade openness was calculated by dividing the sum of imports and exports by GDP per capita. Poultry export volume and value was obtained from Economic Research Service (ERS), USDA. U.S. exports to Canada reflect adjustment to account for differences in measurement between U.S. and Canada. In practice, Canada includes an estimated 4.5% of the value to each transaction to cover inland freight. Real export price was obtained by dividing export value by export volume and then deflating by the Consumer Price Index (CPI) in each importing countries. Due to the unavailability of data on CPI for some countries, we used the European Index to deflate prices in Germany, Middle East Index for Lebanon, and Asian Index for Hong Kong. Table 2 contains a complete list of the 49 countries included in the study. The total number of observations should have been 1176 for the 49 countries over the years 1976–2000. However, the panel data was unbalanced due to missing observations for some countries. For example, data for Russia started from 1992. Thus, the remaining data used for estimation was limited to 876 observations.

Figure 2 presents the exchange rates for the U.S. dollar against the currencies of major poultry importers and exporters in the 1990s. These include the Canadian dollar, Mexican peso, Japanese yen, Russian ruble, euro, Hong Kong dollar, Brazilian real, and Thai baht. The monthly agricultural exchange rates from January 1990 to December 2004 are obtained from the ERS, USDA. While the Canadian dollar was undervalued against the U.S dollar in the 1990s, it has gradually appreciated in value since 2001. At the aftermath

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1The Penn World Tables 6.1 contains national accounts economic time series data on a comprehensive list of countries. The expenditure values, such as “real gross domestic product per capita,” are based on denominations using a common set of international prices and currencies. This allows for more accurate comparisons of cross-national real quantities over time. The real exchange rate relative to the U.S. dollar for each country was calculated with the price level of GDP.
of the Mexican peso crisis in 1994, the peso depreciated greatly against the U.S. dollar in the 1990s, but later appreciated to the pre-1990 level by 2004. The Japanese yen appreciated in the early 1990s, and experienced relative depreciation against the U.S. dollar from then on with some variation around the trend. At the end of 2004, the exchange rate between the Japanese yen and the U.S. dollar came close to the 1990 level. The Russian ruble was extremely volatile between 1991 and the mid of 1995, due to a very unstable Russian economy. Afterward, the ruble appreciated dramatically against the U.S dollar. In contrast to the exchange rate of one U.S. dollar to 191.44 rubles in 1990, by the year 2004, one dollar was equivalent to 15.67 rubles.

*Figure 2* U.S. Dollar Exchange Rate Against Currencies of Major Importers/Exporters.
The exchange rates between the U.S. dollar and the currencies of its major poultry export competitors (Brazil, Thailand, EU, and China) have undergone dramatic changes in recent years. The Brazilian real has depreciated sharply against the U.S. dollar since the early 1990s. This makes Brazilian exports even more competitive on top of its lower labor costs. During this period, the Thai baht also appreciated against the U.S. dollar, ensuring its comparably low export prices. Although the Euro depreciated against U.S. dollar earlier on in the late 1990s, its value became much stronger after 2000, making EU agricultural exports less competitive relative to the United States. The Hong Kong dollar appreciated against the U.S. dollar until mid-1998 but depreciated afterwards.

4. ECONOMETRIC METHODS

The estimated empirical model is based on a standard export demand equation augmented by three alternative measures of exchange rate volatility and a measure of trade openness. Similar model specification (without the trade openness variable) can be found in several past studies on the impact of exchange rate volatility on exports (Asseerly & Peel, 1991; Chowdhury, 1993; Doganlar, 2002). The empirical analysis used a multicountry data set of U.S. poultry exports with its trading partners together with other fundamental economic control variables, such as prices, exchange rates, and income. The basic export demand equation is given as

$$\ln(X_{it}) = \beta_0 + \beta_1 \ln(Y_{it}) + \beta_2 \ln(P_{it}) + \beta_3 \ln(XRAT_{it}) + \beta_4 V_{it} + \beta_5 OPEN_{it} + \epsilon_{it}$$ (1)

where $X_{it}$ represents export volume, $Y_{it}$ denotes the importing country’s income, $\beta_1$ is the income elasticity (and the expected sign is positive), $P_{it}$ denotes the unit export price, $\beta_2$ is the price elasticity of demand for exports (and the expected sign is negative), $XRAT_{it}$ denotes exchange rate levels in foreign currency per U.S. dollar, and $\beta_3$ is the exchange rate elasticity. Assuming law of one price, a devaluation of one country’s currency will increase its exports because exports in the devalued currency are relatively cheaper. This implies that the devalued currency exports become more competitive in the world market (ceteris paribus). $V_{it}$ measures exchange rate risk, and $\beta_4$ is the estimated coefficient on exchange rate risk. As discussed earlier, the sign for $\beta_4$ is ambiguous since it could take either a negative or positive sign. In order to account for the potential impact of trade policy reforms and other institutional factors, the trade openness variable ($OPEN$) was included. Openness to trade is measured as the ratio of total trade as a percentage of GDP. This is a commonly used proxy variable in the trade and development literature to capture the effect of trade policies and institutional changes.

Panel unit root tests were performed for all data series. The Levin, Lin, and Chu (LLC) test (2002) and Im, Pesaran, and Shin (IPS) test (2003) were used to determine whether the data series under study contain unit roots. The LLC test was used to evaluate the null hypothesis that each individual variable is nonstationary against the alternative that all individual time series are stationary. The LLC test assumes that $\rho$ is identical across all cross-sections, though it allows for individual-specific intercepts and time trends. In contrast, the IPS test is a unit root test for dynamic heterogeneous panels based on the mean of individual unit root statistics. The null hypothesis requires that $\rho_i = 1$ for all individuals against the alternative that there is at least one cross-section that has $\rho_i < 1$. Since both tests have the null hypothesis of non-stationarity, a rejection of the null hypothesis suggests that the data series are stationary. Empirical results from both the LLC and IPS
tests indicate that the null hypothesis could be rejected at the 5% level of significance. This implies that the variables are stationary and there is no need to perform additional time series analysis (e.g., cointegration analysis).

Since economic theory does not suggest a particular measure of exchange rate risk, the choice of volatility measures is subjective. It is suspected that the empirical results may be sensitive to the choice of exchange rate volatility measures. In order to investigate the robustness of the results and examine whether different measurements of volatility have varying effects on the empirical results, three alternative measures that seem appropriate for an annual panel data set were employed.

Following Thursby and Thursby (1985) and Bailey, Tavlas, and Ulan (1986), the first volatility measure used is the absolute percentage change in exchange rate levels, i.e.

\[ V_1 = \frac{|e_t - e_{t-1}|}{e_{t-1}} \quad (2) \]

where \( e \) is the “spot” exchange rate and \( t \) refers to time. Following the literature (Chowdhury, 1993; Klein, 1990; Koray and Lastrapes, 1989), the second exchange rate volatility measure used is the standard deviation of the growth rate of the nominal exchange rate

\[ V_t = \left( \frac{1}{m} \sum_{i=1}^{m} (e_{t+i-1} - e_{t+i-2})^2 \right)^{1/2} \quad (3) \]

where \( e \) is the real exchange rate and \( m \) is the order of the moving average. Taking into account the characteristics of the data under study, the lag order is set to two, which means that it is a moving average over two years.

The third volatility measure used is the variance of the “spot” exchange rate around its trend, employed by Thursby and Thursby (1987)

\[ \ln e_t = \alpha_0 + \alpha_1 t + \alpha_2 t^2 + e_t \quad (4) \]

This volatility measure includes a quadratic term which allows for nonlinear trends in the exchange rate in levels. The estimation of the parameters in equation (1) requires the consideration of two econometric specification issues: the presence of unobserved effects and the potential for endogeneity of some of the explanatory variables (Hsiao, 2003). Ordinary least squares (OLS) estimates of equation (1) may yield biased and inconsistent estimates for various reasons.

First, for a large and diverse cross-section of countries as in this study, OLS is subject to an unobservable heterogeneity bias. A common remedy is the specification of a model that includes country-specific fixed effects in the panel regressions. The result from a Hausman (1978) specification test suggests that a fixed effects model is more appropriate than a random effects model. The fixed-effects (within-groups) estimator, which accounts for the unobserved country-specific effects, requires the transformation of equation (1) so that each variable for each country is normalized in such a way that the time-invariant country-specific effects are removed. The unobserved and specific country effects are reflected in different intercepts for various countries. This may include the effects of distance, cost of transportation in most countries (except Canada), demographical characteristics such as languages, culture, and so forth. These factors are usually unique to the individual countries.
For a cross-section of countries of various sizes, as in this study, and given the notable growth in poultry meat trade, it is plausible to expect the presence of heteroskedastic errors. Bartlett’s test for heteroskedasticity was applied. Under the null hypothesis that the disturbances are homoskedastic, the Bartlett statistic is distributed as $\chi^2$ with $N - 1$ degrees of freedom. The null hypothesis of homoskedastic errors was easily rejected at the 5% significance level. In order to account for cross-sectional heterogeneity, a feasible generalized least squares (FGLS) estimation technique was applied to the data (Baltagi, 2001, pp. 79–80). The improved statistics, including substantially lower sum of squared residuals and higher adjusted $R^2$ indicate the existence of intercountry heterogeneity and justifies the adoption of the FGLS technique.

Second, there is the potential for simultaneity bias because the causal link between exports and exchange rate volatility may be bidirectional. If the endogeneity problem is confirmed, then an instrumental variable (IV) estimation method will be more appropriate. The Hausman (1978) test was used to determine if endogeneity problem is an issue. Results from the Hausman test indicate that the null hypothesis of no simultaneity bias could not be rejected at the 5% significance level. As a result, FGLS fixed effect model estimates are efficient and consistent.

Furthermore, given the extended time span of the dataset (up to 25 years for several countries), it is reasonable to hypothesize that there was at least one regime (structural) change. Thus, Chow tests for structural break were performed on U.S. aggregate poultry exports over the entire data sample (1976–2000). The Chow test result indicates that there was a structural break in 1985. Therefore, the subsequent analysis was performed over two subperiods: 1976–1985 and 1986–2000. The empirical results are reported in the next section.

### 5. EMPIRICAL RESULTS

Table 3 presents the empirical results for the estimated fixed effects form of equation (1) using the three alternative measures of exchange rate volatility (i.e., absolute percentage change, moving average, and variance around its trend). As shown in Table 3, most of the estimated elasticities from all three models are very similar in the two subperiods. The main exceptions are the estimates for exchange rate volatility. Over the two subperiods, price, income, and openness to trade are all significant at the 5% level and the signs are as expected. For both subperiods, growth in foreign importing countries’ income has significantly positive effect on U.S. poultry trade at the 1% level for each of the three model specifications. The elasticity of foreign income ranges from 0.60 (absolute percentage change) to 0.62 (variance around trend) in the first subperiod and from 1.57 (absolute percentage change) to 1.61 (moving average of standard deviation) in the second subperiod. As expected, higher foreign income stimulates export demand for U.S. poultry meat. The significant increase in the size of the foreign income elasticity between the first and second subperiods may be reflecting the effect of growth in the global economy in the 1990s. It is plausible to infer that global income growth in the decade of the 1990s stimulated foreign demand for U.S. poultry exports.

The effect of changes in real export price are statistically significant at the 5% level and the price elasticity are $-0.45$, $-0.50$, and $-0.50$, respectively, for the first subperiod and $-0.69$, $-0.71$, and $-0.72$ for the second subperiod. This implies that U.S. poultry meat exports became more sensitive to price fluctuations in the export market during the second subperiod. This finding may reflect the increasing competitiveness of the world
Table 3. Estimation Results for U.S. Poultry Export Demand Model for Exchange Rate Volatility

<table>
<thead>
<tr>
<th></th>
<th>Measure 1</th>
<th>Measure 2</th>
<th>Measure 3</th>
<th>Measure 1</th>
<th>Measure 2</th>
<th>Measure 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Export Price</td>
<td>−0.449**</td>
<td>−0.499**</td>
<td>−0.498**</td>
<td>−0.688**</td>
<td>−0.707**</td>
<td>−0.718**</td>
</tr>
<tr>
<td>Income</td>
<td>(−5.176)</td>
<td>(−5.422)</td>
<td>(−5.122)</td>
<td>(−10.428)</td>
<td>(−11.788)</td>
<td>(−11.644)</td>
</tr>
<tr>
<td>Exchange Rate</td>
<td>−0.623**</td>
<td>−0.698**</td>
<td>−0.696**</td>
<td>−0.013</td>
<td>−0.002</td>
<td>−0.008</td>
</tr>
<tr>
<td>Volatility</td>
<td>(−4.619)</td>
<td>(−5.099)</td>
<td>(−4.789)</td>
<td>(−0.259)</td>
<td>(−0.041)</td>
<td>(−0.159)</td>
</tr>
<tr>
<td>Volatility</td>
<td>−3.16E-03**</td>
<td>3.28E-08</td>
<td>2.60E-08**</td>
<td>4.42E-06**</td>
<td>5.78E-08</td>
<td>1.60E-08*</td>
</tr>
<tr>
<td>Openness</td>
<td>(−3.143)</td>
<td>(−0.483)</td>
<td>(−2.663)</td>
<td>(−2.915)</td>
<td>(−1.1623)</td>
<td>(−1.703)</td>
</tr>
<tr>
<td>Openness</td>
<td>0.004**</td>
<td>0.004**</td>
<td>0.004**</td>
<td>0.008**</td>
<td>0.008**</td>
<td>0.008**</td>
</tr>
<tr>
<td>Openness</td>
<td>(−2.443)</td>
<td>(−2.552)</td>
<td>(−2.689)</td>
<td>(−2.311)</td>
<td>(−2.323)</td>
<td>(−2.232)</td>
</tr>
<tr>
<td>R²</td>
<td>0.997</td>
<td>0.997</td>
<td>0.998</td>
<td>0.943</td>
<td>0.938</td>
<td>0.938</td>
</tr>
</tbody>
</table>

Notes. The student t values are in parentheses. Measures 1, 2, and 3 denote the three alternative measures of volatility: 1 = absolute exchange rate percentage change; 2 = moving average of standard deviation; 3 = variance around trend.

*Significant at the 10% level and **Significant at the 5% level.

poultry market dominated by the United States and a few other low-cost producers such as Brazil, Thailand, and China. Thus, if U.S. poultry price rises, foreign consumers may substitute U.S. poultry meats with domestically produced chicken or imported chicken from other countries with lower prices. Furthermore, as expected, changes in the levels of exchange rate have a negative effect on poultry export volume in the first subperiod for all three model specifications. This outcome is consistent with theory and results from previous studies (Batten & Belongia, 1986; Cho, Sheldon, & McCorriston, 2002). However, in the second period, exchange rates in levels appear to be less important in the determination of U.S. poultry export volume. Also, the effect of a foreign country’s trade openness on U.S. poultry exports is statistically significant at the 5% level in both periods. However, the openness impact is relatively small with coefficient estimates ranging from 0.004 for all volatility measures in the first period to 0.008 in the second. Since this variable is a proxy for a country’s institutional changes over the years, it suggests that poultry trade was not affected much by foreign institutional changes.

Of special interest is the impact of exchange rate volatility on U.S. poultry exports. As earlier hypothesized, the choice of volatility measures appear to matter as the empirical results vary depending on which of the three alternative exchange rate volatility measures is under consideration. The first volatility measure (absolute percentage of change) is statistically significant at the 5% level across both periods. However, the signs vary across periods. While this measure of volatility is negatively related to export volume in the first subperiod, the sign is positive in the second period. In contrast, the second measure of volatility (moving average of standard deviation) is positively correlated with exports, but not statistically significant at the 5% level in either of the two subperiods. The result for the third volatility measure (variance around trend) is consistently positive and statistically significant across both subperiods.

Overall, five of the six possible estimates for volatility across the two subperiods indicate that increased exchange rate volatility corresponds to an increase in U.S. poultry exports. Thus, it is reasonable to conclude from this empirical result that exchange rate risk has a positive effect on U.S. poultry export sales. This conclusion is consistent with

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previous theoretical exchange rate risk model predictions which showed the possibility of a positive impact of exchange rate volatility on trade (DeGrauwe, 1988; Dellas & Zilberfarb, 1993; Giovannini, 1988; Viaene 1992). Furthermore, current results are also consistent with empirical finding in Langley, et al. (2002) that found that Thai poultry export sales responded positively to exchange rate volatility. Combined, these two empirical studies of the international poultry market suggest that competing poultry exporters in two different countries (Thailand and U.S.) behave similarly and exhibit identical responses to market forces, specifically, exchange rate risk.

6. CONCLUDING REMARKS

The potential effect of exchange rate risk on trade has been a subject of much debate and controversy among trade economists. The available empirical evidence is generally ambiguous on the possible impact of exchange rate uncertainty on bilateral trade flows. Furthermore, the vast majority of the past studies only focused on aggregate trade flow data. The lack of extensive literature based on commodity level data may be partially responsible for the conflicting empirical evidence. It is more plausible to assume that exchange rate volatility effect would differ across commodities. Despite the existence of past studies that have examined the impact of exchange volatility on the agricultural sector, not many used commodity level data (Batten & Belongia, 1986; Cho, Sheldon, & McCorriston, 2002; Langley, Mohanty, Guigale, & Meyer, 2002).

This paper re-examines the relationship between exchange rate volatility and U.S. poultry exports using a comprehensive panel data including 49 importers over two subperiods: 1976–1985 and 1986–2000. The empirical analysis was characterized by two key elements. First, this study focused on the effect of exchange rate risk on a particular agricultural commodity: poultry products. This is in contrast to most previous studies that used more aggregated trade data, in which it is assumed that the effects of exchange rate volatility are the same in direction and magnitude across commodities or sectors. Second, three alternative measures of exchange rate risk were used in order to check for the sensitivity of empirical results to the choice of exchange rate volatility measure.

For the more recent subperiod, the empirical results suggest that two of the three exchange rate volatility measures indicate a statistically significant and positive impact on foreign demand for U.S. poultry exports. The exception is the moving average exchange rate volatility estimate which is also positive, but not statistically different from zero at conventional significance levels. The estimated elasticity for the other variables (exchange rate, real price, national income and openness) has the expected signs and is statistically significant. Overall, combining the empirical results from the two subperiods and across the three alternative measures of volatility, it is reasonable to conclude that the effect of exchange rate volatility on U.S. poultry exports is positive and that the choice of volatility measures does matter. While the first (absolute percentage change) and third (variance around trend) measures of volatility produce statistically significant estimates across the two sub-periods, the second measure of volatility (moving average of standard deviation) failed to produce a statistically significant estimate in either of the two sub-periods under consideration. So, the choice of exchange rate volatility measures matter in empirical investigations of this nature.

Furthermore, when data is available, future studies should consider the inclusion of foreign direct investment (FDI) as an explanatory variable in the model of agricultural export behavior. This is necessary because of the increasing importance of foreign direct
investment in international agricultural and food sectors (Bolling, Samwaru, & Crook, 1999). Lack of extensive commodity and country level data on FDI in the poultry industry precludes its inclusion in the current study. The results from this study are consistent with theoretical predictions of exchange rate models by DeGrauwe (1988) and Giovannini (1988). The finding of a positive relationship between U.S. poultry exports and exchange rate volatility is also comparable to empirical results from a similar study for Thailand in Langley, et al. (2002). Finally, given current knowledge, we recommend that future analysis of exchange rate volatility effects should not rely only on inference from a single measure of volatility, but should explore multiple measures of exchange rate volatility to check the robustness of the results. Also, similar analytical framework adopted in this study can be extended to other agricultural commodities.

REFERENCES


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