International Trade and Competitiveness of Lake Victoria Fillets in the EU

Andrew Muhammad
Department of Agricultural Economics
Mississippi State University
PO Box 5187
Mississippi State, MS 39762
Phone: (662) 325-0200
Fax: (662) 325-8777
E-mail: muhammad@agecon.msstate.edu

Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Portland, OR, July 29-August 1, 2007

International Trade and Competitiveness of Lake Victoria Fillets in the EU

Abstract

Given the importance of EU demand for chilled fish fillets to the exporting sectors in Tanzania and Uganda, this study estimated the EU's import demand for fillets by country of origin to assess the competitiveness of exporters. Results imply that prices in Tanzania and Uganda had an insignificant impact on total imports expenditures in the EU. Conditional and unconditional cross-price effects indicated that exports from Lake Victoria did not compete with exports from other suppliers, such as Iceland, Norway and ROW. Import demand forecasts showed that market share in the EU should remain relatively unchanged given the trend in prices.

Key Words: fillets, import demand, EU, Lake Victoria

JEL Classifications: F17, Q17, Q11

International Trade and Competitiveness of Lake Victoria Fillets in the EU

1. Introduction

In 2005, the 25 member states of the EU were the largest importers of chilled fish fillets in the world. That year the EU imported 268.5 million kilograms (kg) valued at $1.6 billion. This represented a 6 percent increase in quantity and a 16 percent increase in value when compared to the previous year. When considering individual countries in 2005, eight EU-member states were among the top ten importers in the world. These included (in order of value): France, Germany, Belgium, Italy, United Kingdom, Sweden, Netherlands and Spain, where import values ranged from $91.7 million to $315 million (UNCOMTRADE, 2006).

In 2005, intra-EU imports of chilled fish fillets were 165.4 million kg and extra-EU imports were 122 million kg. These were 57 and 43 percent of total imports respectively.[1] That year, the top exporters to the EU were Iceland, Norway, Tanzania and Uganda. Exports from these countries were 17.94, 31.73, 21.98, and 21.07 million kg respectively, and valued at €139.8, €178.9, €89.0, and €92.8 million respectively. Combined, these countries accounted for 76 percent of the total quantity of extra-EU imports and 77 percent of total import value (Eurostat, 2006).

The importance of the EU to the fish exporting industries in Tanzania and Uganda can not be understated. Since the lifting of EU import bans on fish from the Lake Victoria region in 2000, fish exports grew approximately 115 percent per year on average for both countries. Growth in Uganda has been so rapid that fish became the second largest source of export revenue for the country (Uganda Export Promotion Board, 2005; Abila, 2000). The primary fish export from Tanzania and Uganda to the EU is Nile perch, and as noted by Abila (2003), the development of the fish processing sector in Lake Victoria riparian countries was the direct result of the extensive growth in Nile perch demand in developed countries. Currently, the EU imports from 600 to 800 tons of chilled Nile perch fillets per week from Lake Victoria's riparian states and accounts for about 80 percents of all chilled fillet exports from Tanzania and Uganda (UNCOMTRADE, 2006; Josupeit, 2005).[2]

The purpose of this study is to estimate the import demand for chilled fish fillets by country of origin for the EU. Estimation results allow for determining the competitiveness of Tanzanian and Ugandan fillets in EU markets when compared to other competing exporters such as Iceland, Norway, and the rest of the world. Given the importance of EU demand for chilled fish fillets to the exporting sectors in Tanzania and Uganda, an assessment of the competitiveness of Tanzania and Ugandan fillets in the EU gives insight into the outlook for the Lake Victoria region. Specific objectives of this study are (1) to econometrically estimate the demand for imported chilled fillets in the EU by country, (2) to utilize the empirically estimated import demand parameters to provide elasticity measures of demand, and (3) to utilize estimated parameters to project future short-run import demand for the EU to determine the outlook for the fish exporting industries in Tanzania and Uganda.

2. Methodology

2.1 The Differential Production Model

The differential production model is used to estimate the EU's output supply and import demand

---

[1] According to Eurostats, total imports for 2005 were 287.4 million kg. This was slightly off from the UN statistic, 268.5 million kg.

[2] Lake Victoria is shared between three countries: Tanzania (which possesses 49 percent), Uganda (45 percent) and Kenya (6 percent) (Bokea and Ikiara, 2000). Kenyan exports are small when compared to Uganda and Tanzania.

for chilled fish fillets. Theoretical derivation of the model can be found in Laitinen (1980) and Theil (1980). Past applications to import demand analysis include Davis and Jensen (1994), Washington and Kilmer (2002a), and Washington and Kilmer (2002b). In this paper it is assumed that the EU imports fillets through importing firms, where firms import from various exporting countries and resell the imported product domestically or internationally. The output of these firms is the total quantity of imported fillets sold, and the inputs are the factors of production required in wholesale trade and the imported fillets. If we assume product differentiation across exporting countries then the input demand equations will not only be the demand for value added inputs such as labor, energy and capital, but also the demand for chilled fillets from each exporting country.

In a two-step procedure we get the output supply equation and import demand system. The differential output supply equation, expressed in finite 12-month log changes to correct for seasonality (Kmenta, 1986, 325–326), is as follows:

$$DX_t = \varphi\, Dp_t + \sum_{j=1}^{N} \pi_j\, Dw_{jt} + \varepsilon_t \, . \qquad (1)$$

DX_t is the finite version of the Divisia volume input index (Divisia index), where

$DX_t = \sum_{i=1}^{n} \bar{f}_{it}\, Dx_{it}$, $\bar{f}_{it} = (f_{it} + f_{it-12})/2$, and $Dx_{it} = \log(x_{it}) - \log(x_{it-12})$. f_i is the share of the ith import in the total cost of all fillet imports $(w_i x_i / \sum_i w_i x_i)$. w_i and x_i are the price and quantity of chilled fillets from exporting country i; $Dw_{it} = \log(w_{it}) - \log(w_{it-12})$ and $Dp_t = \log(p_t) - \log(p_{t-12})$, where p is the output price. φ and π are the parameters to be estimated, where φ measures the impact of percentage changes in output price on the Divisia index and the π_j ’s measure the impact of percentage changes in input prices on the Divisia index. ε_t is a random disturbance term. The Divisia index is an index of the EU's total expenditures on imported chilled fillets. *p* is the wholesale or domestic price at which importing firms resell to other firms. The w_j's are the prices paid for chilled fillet imports from each of the exporting countries and the price of value added resources. *N* is the total number of inputs used, which is equal to the sum of the number of exporting countries and number of value added inputs. *n* is the number of exporting countries/imported goods.

The differential derived demand model, which is used to estimate the system of import demand equations is specified as follows (also expressed in 12-month finite log changes):

$$\bar{f}_{it}\, Dx_{it} = \theta_i^* DX_t + \sum_{j=1}^{n} \pi_{ij}^* Dw_{jt} + u_{it}\ . \qquad (2)$$

Similar to equation (1), $\bar{f}_{it} = (f_{it} + f_{it-12})/2$ and $f_i = (w_i x_i / \sum_i w_i x_i)$. $Dx_{it} = \log(x_{it}) - \log(x_{it-12})$ and $Dw_{it} = \log(w_{it}) - \log(w_{it-12})$, where x_i and w_i represent the quantity and price of fillets from source country *i*. DX_t is the Divisia index. θ_i^* and π_{ij}^* are parameters to be estimated, where θ_i^* is the marginal factor share coefficient and π_{ij}^* measures the conditional price effects. u_{it} is a random disturbance term. The differential derived demand model requires that the following parameter restrictions be met in order for the model to conform to theoretical considerations: $\sum_j \pi_{ij}^* = 0$ (homogeneity), and $\pi_{ij}^* = \pi_{ji}^*$ (symmetry).

From the differential derived demand model we get the conditional own-price/cross-price elasticity and the conditional Divisia index elasticity,

$$\eta_{xw}^c = \frac{\pi_{ij}^*}{\bar{f}_i}\,, \qquad (3)$$

$$\eta_{xX} = \frac{\theta_i^*}{\bar{f}_i}\,. \qquad (4)$$

The conditional own-price/cross-price elasticity measures the impact of source-specific price changes on source-specific quantities holding total imports constant. As import prices change, particularly relative prices, firms change how the total imported is allocated across the exporting countries. The conditional Divisia index elasticity measures the impact of percentage changes in total import expenditures on fillet imports from a given country.

Substituting the right-hand side of equation (1) for the Divisia index term in equation (2), we get the demand for a source-specific import in terms of the changes in output price and input prices

$$\bar{f}_{it}\, Dx_{it} = \theta_i^* [\varphi\, Dp + \sum_{j=1}^{N} \pi_j Dw_j] + \sum_{j=1}^{n} \pi_{ij}^* \, Dw_j \ . \qquad (5)$$

Equation (5) can be interpreted as the unconditional derived demand equation since changes in source-specific import demand are no longer conditional on total imports but a function of changes in input/import and output prices (Laitinen, 1980). From equation (5) we get the unconditional derived demand elasticities: the unconditional elasticity of derived demand with respect to output price and the unconditional own-price/cross-price elasticity. These are calculated respectively as:

$$\eta_{xp} = \frac{d\log(x_i)}{d\log(p)} = \frac{\theta_i^*}{\bar{f}_i}\varphi \qquad (6)$$

$$\eta_{xw} = \frac{d\log(x_i)}{d\log(w_j)} = \frac{\theta_i^*}{\bar{f}_i}\pi_j + \frac{\pi_i^*}{\bar{f}_j} \qquad (7)$$

Equation (6) measures the impact of percentage changes in resell (output) prices on fillet imports from country *i*. Equation (7) measures the total impact of changes in the price of imports from country *j* on imports from country *i*. Unlike the conditional own-price/cross-price elasticity which measures the impact of relative prices, the unconditional elasticity measures the impact of relative price changes as well as the impact of price changes on total imports.

2.2 Forecasting procedure

An objective of this study is to utilize the estimated parameters to project future short-run import demand for the EU with particular focus on fillet exports from Tanzania and Uganda. There are two methods for obtaining quantity forecasts with the differential production model. These include a model-based approach and an elasticity-based approached. The model approach is based on equation (5), which is the unconditional derived demand equation. Given the left-hand side of equation (5), quantity forecasts are not easily obtained. Kastens and Brester (1996) suggested a Taylor series expansion of the left-hand side when forecasting with the Rotterdam model. The Rotterdam model is parametrically identical to equation (2) and has the same left-hand side as equation (5). However, it is possible to solve equation (5) for quantity. Solving for quantity, the model-based forecasting equation is

$$x_{it} = \exp\left[\frac{\begin{array}{l}\theta_i^*[\varphi(\log p_t - \log p_{t-12}) + \sum_{j=1}^{N}\pi_j(\log w_{jt} - \log w_{jt-12})] \\ + \sum_{j=1}^{n}\pi_{ij}^*(\log w_{it} - \log w_{it-12})\end{array}}{\dfrac{\dfrac{w_{it}x_{it}}{\sum_{i=1}^{n} w_{it}x_{it}} + \dfrac{w_{it-12}x_{it-12}}{\sum_{i=1}^{n} w_{it-12}x_{it-12}}}{2}} + \log x_{it-12}\right] \qquad (8)$$

Although x_{it} appears on both sides of the equation, the SOLVE procedure in TSP version 5.0, which uses a Gauss-Seidel algorithm, allowed for forecast of x_{it} (Hall and Cummins, 2005b, 199-202).

Kastens and Brester (1996) also suggest elasticity-based forecasts when forecasting with demand systems. There results indicated that elasticity-based forecasts had smaller forecast error than model-based forecasts. This was also the case for Washington and Kilmer (2002a). The forecasting equation using the unconditional elasticities is

$$x_{it} = \left(\eta_{x_i p} \left[\frac{p_t - p_{t-1}}{p_{t-1}} \right] + \sum_{j=1}^{n} \eta_{x_i w_j} \left[\frac{w_{jt} - w_{jt-1}}{w_{jt-1}} \right] + \eta_{x_i w_L} \left[\frac{w_{Lt} - w_{Lt-1}}{w_{Lt-1}} \right] \right) x_{it-1} + x_{it-1} . \qquad (9)$$

$\eta_{x_i p}$ is the unconditional elasticity of derived demand with respect to output price, $\eta_{x_i w_j}$ is the unconditional own-price/cross-price elasticity, and $\eta_{x_i w_L}$ is the unconditional elasticity of derived demand with respect to the price of labor. Equation (9) states that the quantity imported from country *i* in year *t* is a function of the quantity imported the previous year and the percentage changes in output price, country-specific import prices, and the price of labor (w_L).[3]

We determine which of the two approaches has the smaller forecast error. This is accomplished with out-of-sample forecasts and comparing the root mean-squared error of each forecast. All forecasts are based on theory constrained estimates. Murphy et al. (2004) and Kastens and Brester (1996) note that forecast error improves when parameters are theoretically constrained, even when constraints are statistically rejected. Once the forecasting method is selected, EU fillet imports from each country are projected from June 2006 to May 2007.

3. Empirical Results

3.1 Data and Descriptive Statistics

The External trade section of the Statistical Office of the European Communities (Eurostats) provided the data used in this study which was at the 6-digit HS Commodity Classification. Source-specific imported quantities of chilled fillets for the EU were in 100 kilograms and values were in euros. Exporting countries were Norway, Iceland, Tanzania and Uganda. Monthly data was used for estimation and the time period for the data was from September 2000 to May 2006.

---

[3] Estimation results indicated that wages did not significantly impact total import expenditures. Wages were therefore excluded from the elasticity forecasting equation.

Import prices were calculated by dividing the value of the commodity by the quantity, which resulted in a euro per 100 kg measure. The rest of the world (ROW) quantities and values were calculated by subtracting imports for the 4 exporting countries from total extra-EU imports. As a proxy for output price, a per unit value measure for EU fillet exports (intra and extra) was used. Initially, labor, utilities and energy were considered as value added inputs in the model. However, given the high degree of multicollinearity between the indices for these inputs, labor was the only value added input included. Both the out price measure and the wage index were also provided by Eurostats.

Descriptive statistics on model variables are presented in Table 1. The average per unit values (import prices) for Iceland, Norway, Tanzania, Uganda, and ROW were €751.85, €521.42, €421.89 €445.00, and €565.86 per 100 kg respectively. Overall, Uganda and Tanzania received a lower price for chilled fillets when compared to the other exporting countries. The average output price for the EU was €806.58 per 100 kg, which was significantly higher than all import prices. During the data period, Norway had the largest share of the EU market at 25 percent on average. Second was ROW at 24 percent. Iceland and Tanzania has relatively the same market share at 19 percent, and Uganda had the smallest share at 13 percent.

[Place Table 1 approximately here]

3.2 Estimation Results

Estimation of the output supply equation and import demand system was accomplished using the LSQ procedure in TSP version 5.0. This procedure used the multivariate Gauss-Newton method to estimate the parameters in the system (Hall and Cummins, 2005a). The test for AR(1) in the differential production model was accomplished using likelihood ratio (LR) tests. The autocorrelation parameter was obtained using a full information maximum likelihood procedure for non-singular systems found in Berndt and Savin (1975) and Beach and MacKinnon (1979). In addition to autocorrelation, LR tests were used to test for the economic properties of homogeneity and symmetry. Log likelihood values, test statistics, and probability values are presented in Table 2. Results indicate that the hypothesis of no autocorrelation was rejected at the 0.05 significance level. LR tests also indicated that the properties of homogeneity and symmetry could not be rejected. Since no AR(1) was rejected, and homogeneity and symmetry were not rejected, all results have AR(1), homogeneity, and symmetry imposed. Theory suggests that the matrix of conditional price effects be negative semi-definite. This property is confirmed when all eigenvalues of the price coefficient matrix are less than or equal to zero. As verified by inspection, all eigenvalues were nonpositive.

[Place Table 2 approximately here]

Estimation results for the output supply equation are presented in Table 3. The output price parameter estimate (0.085) was positive as expected and significant at the 0.05 significance level. Although wages had a negative impact on the Divisia index (-2.3160), this impact was not significant. This may be the result of using monthly data, where monthly changes in wages had little impact on EU total import expenditures on chilled fillets. The impact of source-specific prices on the Divisia index was negative for all countries except Uganda, and significant for Iceland, Norway and the ROW. The input price coefficient for Iceland, Norway and ROW were -0.222, -0.352, and -0.216 respectively. The input price coefficients for Tanzania and Uganda were -0.100 and 0.103 respectively.

The insignificant impact of Tanzanian and Ugandan fish prices on the Divisia index indicates that as prices increased, total import expenditures for the EU did not significantly decrease. Note that the average per-unit values for Iceland, Norway and ROW were €100 to €300 higher than the per-units values for Tanzania and Uganda. Even the maximum prices for Tanzania and Uganda are still comparable to mean prices for Norway and ROW fillets, and were still significantly less than the mean price for Iceland fillets (Table 1). It may be the case that with rising prices, importers continued to purchase fillets from Tanzania and Uganda because of their relative inexpensiveness. This argument would further be strengthened if the conditional own-price effects and elasticities were also insignificant for Tanzania and Uganda. However, according to Table 4 the conditional own-price effects were negative and significant for all countries.

Another explanation for the insignificant relationship between the Divisia index and Tanzanian or Ugandan fillet prices is the degree of the substitutability of fillets from these two countries in the EU. Note that the conditional cross-price effect for Tanzania and Uganda is significantly higher than the cross-price effects between any of the other countries (0.141, see Table 4). The conditional and unconditional cross-price elasticities were also significantly larger for these two countries (1.136 and 0.726, see Table 5). This suggests that as the price of Tanzania fillets increased, EU importers increased their imports from Uganda and vice versa. The cross-prices elasticities being close to unity indicate that substitution may have occurred to the degree that the Divisia index remained relatively unaffected.

[Place Table 3 approximately here]

Conditional import demand estimates for the EU are presented in Table 4. Marginal factor share estimates indicate a positive and significant relationship between chilled fillet imports from all sources and the Divisia volume index. As the EU increased total expenditures on chilled fillet imports, imports from Iceland and Norway had the largest absolute increase

(0.286 and 0.284). The increase in ROW imports was slightly smaller (0.232). However, the increase for Tanzania and Uganda (0.054 and 0.145) was relatively lower when compare to the other exporting countries. The conditional own-price effects were all negative which was expected. Each were significant at the 0.01 significance level and there was little difference in the estimates across the exporting countries (-0.192, -0.152, -0.157, -0.155 and -0.138 for Iceland, Norway, Tanzania, Uganda and ROW respectively). Cross-price parameter estimates indicate a significant competitive relationship between Iceland, Norway and the ROW, but with the exception of Iceland and Tanzania, no significant relationship existed between the Lake Victoria countries and the other competing exporters. As previously mentioned, a relatively strong competitive relationship existed between fillets from Uganda and Tanzania, where the cross-price estimate for these two countries was 0.141, which was the largest of all the conditional cross-price effects. Iceland and Tanzania aside, this suggests that EU importers viewed fillets from Lake Victoria as a separable group where competition existed between Tanzania and Uganda, but little to no competition existed with the other exporters.

[Place Table 4 approximately here]

3.3 Conditional and Unconditional Elasticities

Table 5 presents estimates of the conditional elasticities of derived demand for imported chilled fillets (calculated at the mean). The Divisia index elasticities, which measure the responsiveness of source-specific imports to changes in total import expenditures, are 1.484, 1.132, 0.276, 1.161 and 0.977 for Iceland, Norway, Tanzania, Uganda and ROW respectively. These elasticities indicate that a percentage increase in the Divisia index increases EU imports of chilled fillets from these countries by their elasticity values. All Divisia index elasticities were significant at the 0.01 significance level, with the exception of Tanzania which was significant at the 0.05

significance level. When compare to the other exports, the Divisia index elasticity for Tanzania was relatively small. During the data period, EU imports from Tanzania had the smallest standard deviation and minimum/maximum range (Table 1). This suggests that changes in total EU imports or expenditures had a relatively smaller impact on imports from Tanzania given the smaller variability.

The conditional own-price and cross-price elasticities measure the impact of import price changes on source-specific imports holding total imports constant. As import prices changed, particularly relative prices, EU firms changed how the total imported was allocated across the exporting countries. The own-price elasticities were -0.998, -0.605, -0.805, -1.243 and -0.582 for Iceland, Norway, Tanzania, Uganda and ROW respectively. All are significant at 0.01. Overall, EU demand for chilled fillet imports was inelastic for all countries except Uganda.

[Place Table 5 approximately here]

Conditional cross-price elasticities of derived demand for imported chilled fillets in the EU indicated significant competitive relationships between Iceland, Norway and ROW, but no significant relationship existed between these countries and Uganda or Tanzania (except Iceland and Tanzania). Given a percentage increase in the price of fillets from Iceland, the EU increased imports from Norway by 0.386 percent, Tanzania by 0.182 percent, and ROW by 0.199 percent. EU imports from Iceland and the ROW increased by 0.503 and 0.347 percent respectively given a percentage increase in Norway fillet prices, and imports from Iceland and Norway increased by 0.245 and 0.329 percent respectively given a percentage increase in ROW prices.

Cross-price elasticities indicated a strong competitive relationship between Ugandan and Tanzanian fillets in the EU. While a percentage increase in Ugandan prices increased EU imports from Tanzania by 0.726 percent, a percentage increase in Tanzania prices increased EU imports from Uganda by 1.136 percent. Both elasticities were significantly larger when compared to the other cross-prices elasticities. These elasticities also suggested that given changes in relative prices Tanzanian fillets were more likely to be replace with Ugandan fillets than the other way around.

Unconditional elasticities of derived demand are reported in Table 6. Although significant, the impact of EU prices (output prices) on source specific imports was small, particularly for Tanzania. For every percentage increase in EU prices, imports from Iceland increased by 0.125 percent, but imports from Norway, Tanzania, Uganda and ROW increased only by 0.096, 0.023, 0.098 and 0.083 percent respectively. Unconditional own-price elasticities all indicate a significant inverse relationship between source-specific prices and quantities. Results show that the demand for Iceland and Uganda fillets was elastic (-1.328 and -1.124 respectively). The demand for fillets from Norway was also elastic but close to unit elastic (-1.004) and the demand for Tanzania fillets was inelastic (-0.833). Note that the conditional and unconditional own-price elasticities for Tanzania and Uganda were very close. This was due to the insignificant relationship between the price of fillets from Tanzania and Uganda and the Divisia index.

Given that the unconditional cross-price elasticity incorporates the impact of source-specific price changes on total imports/expenditures, a change in fillets prices from any country could impact total imports so much so that the total import effect could out weigh the impact of relative prices. Given a percentage increase in the price of Iceland fillets, EU imports from Norway and Tanzania increased by 0.135 and 0.121 percent respectively, but imports from Uganda decreased by 0.158 percent. Given a percentage increase in the price of Norway fillets, EU imports from Tanzania and Uganda both decreased by 0.167 and 0.522 percent respectively.

Given a percentage increase in ROW prices, EU imports from Iceland, Tanzania and Uganda decreased by 0.075, 0.093, and 0.130 percent respectively, but imports from Norway increased by 0.085 percent.

Conditionally, Ugandan fillets were more likely to be substituted for Tanzanian fillets given changes in relative prices, the opposite is true unconditionally. However, note that the impact of prices for both countries on the Divisia index was insignificant, which suggests that the conditional and the unconditional relationships are statistically the same, and that the true relationship is the conditional relationship. This is because the difference in the unconditional and conditional elasticities is due to source-specific prices significantly impacting the Divisia index. This was not the case for Tanzania and Uganda.

3.4 Forecasting Procedure and Import Projections

In the forecasting and simulation procedure, it was determined which of the two approaches (model-based and elasticity-based) most accurately forecasted EU import demand. Out-of-sample forecasts were used to estimate the forecast error for the two approaches. Equations (1) and (2) were estimated using all except the last 12 months of the data sets (September 2000 to May 2005), and the estimates were used to forecast the remaining years (June 2005 to May 2006). The root mean square error (RMSE) for each approach was compared to determined forecast accuracy. Using the estimates obtained from the full data set (September 2000 to May 2006), the method with the smallest RMSE was used to project futures quantities from June 2006 to May 2007.

The RMSE for the out-of-sample forecasts for 12 periods are presented in Table 7. The average RMSE for the unconditional elasticity approach was 3,436 and the average RMSE for the unconditional model approach was 5,778. Unconditional elasticities were calculated using the mean factors shares for the entire data period. Gustavsen and Rickertsen (2003) note that elasticities for more recent observations may produce smaller forecast error. Given this point, additional forecasts were completed using unconditional elasticities calculated with mean factors shares for the last 12 months of the data period instead of the entire data period. The average RMSE for this procedure was 3,316.

Although the elasticity approaches had the smallest forecast error, all three methods had relatively large RMSE for imports from Norway. This is partly due to the scaling issue with RMSE, since imports from Norway were greater than imports from the other countries. Note that average monthly imports for the entire data period (September 2000 to May 2006) were 1.10, 2.03, 1.81, 1.19, and 1.78 million kg for Iceland, Norway, Tanzania, Uganda, and ROW respectively. While imports from Norway were less than twice the imports from all other sources, the forecast error for Norway was more than triple the forecast error for all other sources, which indicates that in addition to scaling, all three approaches had difficulty in forecasting imports from Norway. Particularly since imports from Tanzania and ROW were also higher on average, but the RMSE were comparable to Iceland and Uganda.

Table 8 presents the projected quantities of EU imports of chilled fillets for the period June 2006 through May 2007. Import demand projections are based on input and output price forecasts assuming a linear trend in prices with a one-year lag and monthly dummies.[4] The average monthly imports for the projection period were 1.89, 3.23, 1.57, 1.74 and 2.50 million kg for Iceland, Norway, Tanzania, Uganda, and ROW respectively. These represented an

[4] The equation use to forecast input and output prices was $P_t = \beta_0 + \beta_1 t + \beta_2 P_{t-1} + \sum_{i=1}^{11} \delta_i D_i + \mu_t$, where P is price, t is a trend variable equal to 1 in September 2000, 2 in October 2000, etc., and the D's are monthly dummy variables.

increase for all countries except Tanzania when compared to the previous 12-month period (June 2005 through May 2006), where monthly import averages were 1.57, 2.63, 1.71, 1.68, and 2.18 million kg for Iceland, Norway, Tanzania, Uganda, and ROW respectively. In comparing the average market share for each country for the projection and the previous 12-month period, projections indicate that Norway is the only country where market share increased, however given the RMSE and the small projected changes, market share is likely to remain unchanged for all countries.

4. Summary and Conclusions

This study assessed the competitiveness of chilled fillets from Tanzania and Uganda in the EU. Given the importance of EU demand for chilled fish fillets to the exporting sectors in Tanzania and Uganda, EU import demand for chilled fish fillets by country of origin was estimated. Results allowed for determining the competitiveness of Tanzanian and Ugandan fillets in EU markets when compare to other competing exporters such as Iceland, Norway, and the rest of the world (ROW). EU import demand was also projected for the period June 2006 through May 2005.

Although Tanzania and Uganda represented a significant share of the EU import market, results showed that chilled fillet prices in these countries had an insignificant impact on total import expenditures in the EU. Additionally, with the exception of the condition cross-price relationship between Iceland and Tanzania, cross-price effects indicated that exports from Tanzania and Uganda do not compete with exports from other countries that supplied fillets to the EU. These results have important implications for the pricing practices of Lake Victoria exporters, because an increase in Tanzanian or Ugandan fillet prices will not lead to a significant substitution of non-Lake Victoria fillets for Lake Victoria fillets. However, given the conditional and unconditional own-price elasticities, which indicated that the demand for fillets from Tanzania was inelastic and the demand for Ugandan fillets were elastic, an increase in fillets prices will lead to greater export revenue for Tanzania, but export revenue for Uganda will decrease.

Lake Victoria not competing with other countries that supply the EU with fillets has two negative implications: (1) as the relative price of fillets increase in another country, the EU will increase imports from sources other than Lake Victoria, and (2) lowering Lake Victoria prices will not increase Lake Victoria market share in the EU. Lake Victoria is the primary source of Nile perch to the EU, and it may be the case that EU importers view Nile perch as a unique product. This may explain the high degree of competitiveness between fillets from Tanzania and Uganda, and the absence of competitiveness between Lake Victoria and other suppliers. Unfortunately, this suggests that an increase in market share resulting from an increase in price competitiveness of one Lake Victoria country will come at the expense of the other. This is somewhat disheartening because both countries have identified their fish exporting sectors as a means of economic development, particular since chilled fillets are a high value- added product that commands a higher return in world markets when compare to other fish products (Dijkstra, 2001). Results do show that competition between the two countries will benefit Uganda more so that Tanzania since the rate at which Uganda fillets were substituted for Tanzanian fillets was greater than the reverse.

Although Tanzanian and Ugandan fillet prices did not significantly impact EU total fillet expenditures (Divisia index), the impact of price changes in Iceland, Norway and ROW will indirectly impact imports from Tanzania and Uganda due to Lake Victoria fillets and fillets from other suppliers being complements (unconditionally) in the EU. Both countries should benefit from a more competitive environment with comparably lower prices which would result in an increase in total EU imports. Conversely, an increase in competitor prices will decrease total imports and hence decrease imports from Lake Victoria.

Lastly, forecast results suggest that given the trend in import and output prices, market share should remain relatively unchanged. Although results show that EU imports from Norway were projected to increase from 2.63 to 3.23 million kg on average, the RMSE for the forecasts for this country was 0.75 million kg, which is more than the difference in the projected and previous-period average. Overall, results suggests that the potential for an increase in Lake Victoria exports to the EU will more likely results from an increase in EU demand than an increase in relative competitiveness.

Table 1. Descriptive statistics on EU imports of chilled fillets by country: September 2000 – May 2006

	Iceland	Norway	Tanzania	Uganda	ROW
Import Price (euros/100 kg)					
Mean	€ 751.58	521.42	421.89	445.00	565.86
Standard Deviation	70.10	60.39	68.62	55.41	70.91
Minimum	282.17	424.24	273.65	326.45	164.53
Maximum	829.54	679.69	567.42	584.39	694.57
Import Quantity (100 kg)					
Mean	10,989	20,280	18,125	11,887	17,756
Standard Deviation	4,371	6,133	2,640	4,057	6,046
Minimum	5,387	9,899	12,558	3,824	9,950
Maximum	28,683	32,666	24,093	19,970	54,840
Import Share					
Mean	0.1923	0.2516	0.1924	0.1256	0.2381
Standard Deviation	0.0287	0.0331	0.0503	0.0240	0.0226
Minimum	0.1386	0.1698	0.1063	0.0563	0.1911
Maximum	0.2407	0.3315	0.3316	0.1669	0.2882
EU(25) variables	Output Price (euros/100 kg)	Wage Index			
Mean	€ 806.58	1.0890			
Standard Deviation	175.57	0.0632			
Minimum	308.04	0.9934			
Maximum	1,114.47	1.2838			

Table 2. Likelihood ratio test results for AR(1) and economic constraints

Model	Log-likelihood Value	LR Statistic	P[$\chi^2_{(j)} \leq$ LR]=.95
AR(1)	566.956		
No-AR(1)	560.114	14.201	3.84(1)[a]
Unrestricted [b]	566.956		
Homogeneity	564.798	4.315	11.07(5)
Symmetry	560.214	9.169	18.31(10)

[a] The number of restrictions are in parenthesis.
[b] The Unrestricted model and the AR(1) model are the same model since No-AR(1) was rejected.

Table 3. Output Supply Estimates of Imported Chilled Fillets in the EU

Input Price Coefficients, π_{ij}						Output Price Coefficient φ
Iceland	Norway	Tanzania	Uganda	ROW	Labor	
-0.2223***	-0.3523***	-0.0998	0.1030	-0.2159***	-2.3160	0.0845**
(0.0344)[a]	(0.1181)	(0.1519)	(0.1440)	(.0389)	(1.6984)	(0.0338)
R^2 = .82						

[a] Asymptotic standard errors are in parentheses.
*** Significance level = 0.01.
** Significance level = 0.05.

Table 4. Conditional Demand Estimates for EU Imports of Chilled Fillets by Country

Exporting Country	Price Coefficients, π_{ij}					Marginal Factor Shares, θ_i
	Iceland	Norway	Tanzania	Uganda	ROW[b]	
Iceland	-0.1921*** (0.0148)[c]	0.0968*** (.0151)	0.0356*** (.0132)	0.0124 (.0140)	0.0472*** (.0095)	0.2857*** (.0234)
Norway		-0.1518*** (.0315)	-0.0136 (.0238)	-0.0140 (.0266)	0.0826*** (.0128)	0.2838*** (.0264)
Tanzania			-0.1569*** (.0395)	0.1413*** (.0392)	-0.0065 (.0119)	0.0537*** (.0246)
Uganda				-0.1547*** (.0479)	0.0150 (.0123)	0.1445*** (.0250)
ROW					-0.1383*** (.0116)	0.2322*** (.0211)
Equation R^2	.85	.64	.37	.31	.83	

[a] Homogeneity and symmetry are imposed.
[b] ROW= rest of the world.
[c] Asymptotic standard errors are in parentheses.
*** Significance level = .01
** Significance level = .05

Table 5. Conditional Divisia and Price Elasticities of the Derived Demand for Imported Chilled Fillets

Exporting Country/good	Elasticities					
	Divisia Index	Conditional Own and Cross-Price				
		Iceland	Norway	Tanzania	Uganda	ROW
Iceland	1.484*** (0.122)[a]	-0.998*** (0.077)	0.503*** (0.079)	0.185*** (0.068)	0.065 (0.073)	0.245*** (0.049)
Norway	1.132*** (0.105)	0.386*** (0.060)	-0.605*** (0.126)	-0.054 (.095)	-0.056 (0.106)	0.329*** (0.051)
Tanzania	0.276** (0.127)	0.182*** (0.068)	-0.070 (0.122)	-0.805*** (0.203)	0.726*** (0.201)	-0.033 (0.061)
Uganda	1.161*** (0.201)	0.100 (0.112)	-0.113 (0.213)	1.136*** (0.315)	-1.243*** (0.385)	0.121 (0.098)
ROW	0.977*** (0.089)	0.199*** (0.040)	0.347*** (0.054)	-0.027 (0.050)	0.063 (0.052)	-0.582*** (0.049)

[a] Asymptotic standard errors are in parentheses.
*** Significant level = .01
** Significant level = .05

Table 6. Unconditional Elasticities of the Derived Demand for Imported Chilled Fillets

Exporting Country/good	Elasticities					
	Output Price	Unconditional Own and Cross-Price				
		Iceland	Norway	Tanzania	Uganda	ROW
Iceland	0.125*** (0.010)[a]	-1.328*** (0.076)	-0.020 (0.097)	0.037 (0.069)	0.218*** (0.072)	-0.075*** (0.026)
Norway	0.096*** (0.009)	0.135*** (0.023)	-1.004*** (0.142)	-0.167* (0.093)	0.061 (0.106)	0.085*** (0.023)
Tanzania	0.023** (0.011)	0.121*** (0.028)	-0.167*** (0.045)	-0.833*** (0.198)	0.754*** (0.198)	-0.093*** (0.027)
Uganda	0.098*** (0.017)	-0.158*** (0.045)	-0.522*** (0.070)	1.020*** (0.020)	-1.124*** (0.379)	-0.130*** (0.043)
ROW	0.083*** (0.007)	-0.018 (0.020)	0.003 (0.031)	-0.125*** (0.009)	0.164*** (0.009)	-0.793*** (0.019)

[a] Asymptotic standard errors are in parentheses.
*** Significant level = .01
** Significant level = .05
* Significant level = .10

Table 7. Out-of-sample forecast RMSE after 12 periods of forecasts

Exporting Country	Unconditional Elasticity	Unconditional Elasticity (12-month average)	Unconditional Model
Iceland	2,388.89	2,349.10	5,450.18
Norway	7,815.80	7,518.95	9,043.79
Tanzania	2,201.78	2,040.70	3,656.12
Uganda	2,335.42	2,180.52	5,366.29
ROW	2,440.00	2,489.47	5,374.09
Average RMSE	3,436.38	3,315.75	5,778.10

Table 8. EU import demand projections from June 2006 through May 2007 (100 kg)

	Exporting Country				
Month-Year	Iceland	Norway	Tanzania	Uganda	ROW
Jun-06	19,302	29,598	15,377	16,382	23,566
Jul-06	19,115	30,477	16,051	16,317	24,807
Aug-06	19,132	30,979	15,313	17,268	24,951
Sep-06	19,950	32,636	15,619	17,635	24,835
Oct-06	18,752	34,103	15,891	17,848	24,948
Nov-06	22,420	33,395	15,043	18,908	25,432
Dec-06	17,351	32,998	15,691	17,657	25,249
Jan-07	16,596	32,954	15,769	17,311	25,180
Feb-07	18,198	33,982	16,422	17,913	28,231
Mar-07	18,587	32,377	15,598	17,150	23,984
Apr-07	18,503	31,582	15,470	16,887	24,015
May-07	18,606	32,565	15,614	17,287	24,359
Forecast Average	18,876	32,304	15,655	17,380	24,963
2005:6-2006:5 Average	15,675	26,332	17,107	16,841	21,719
Forecast Average Market Share	0.166	0.300	0.145	0.159	0.231
2005:6-2006:5 Average Market Share	0.169	0.268	0.172	0.167	0.223

References

Abila, R.O. (2000). The Development of the Lake Victoria Fishery: A Boon or Bane for Food Security. Kenya Marine and Fisheries Research Institute, Kisumu, Kenya.

Abila, R.O. (2003). Food Safety in Food Security and Food Trade Case Study: Kenyan Fish Exports. International Food Policy Research Institute, 2020 Vision Focus Report 10, Brief 8, Washington DC.

Beach, C.M. and MacKinnon, J.G. (1979). Maximum Likelihood Estimation of Singular Equation Systems with Autoregressive Disturbances. *International Economic Review* 20: 459-464.

Berndt, E.R. and Savin, N.E. (1975). Estimation and Hypothesis Testing in Singular Equation Systems with Autoregressive Disturbances. *Econometrica* 43: 937-958.

Bokea, C. and Ikiara, M. (2000). The Macroeconomy of the Export Fishing Industry in Lake Victoria. International Centre for Economic Growth, Nairobi, Kenya.

Davis, G.C. and Jensen, K.L. Jensen (1994). Two-Stage Utility Maximization and Import Demand Systems Revisited: Limitations and an Alternative. *Journal of Agricultural and Resource Economics* 19: 409-424.

Dijkstra, Tjalling. (2001). Export Diversification in Uganda: Developments in Non-Traditional Agricultural Exports. African Studies Centre Working Paper 47.

Eurostats. (2006). External trade detailed data. http://epp.eurostat.ec.europa.eu/portal/page?_pageid=0,1136217,0_45571467&_dad=portal&_schema=PORTAL. Accessed 20 October 2006.

Gustavsen, G.W. and Rickertsen, K. (2003). Forecasting Ability of Theory-Constrained Two-Stage Demand Systems. *European Review of Agricultural Economics* 30: 539-558.

Hall, B.H. and Cummins, C. (2005a). *Reference Manual Version 5.0*. Palo Alto, California: TSP International.

Hall, B.H. and Cummins, C. (2005b). *User's Guide Version 5.0*. Palo Alto, California: TSP International.

Josupeit, H. (2005). Nile Perch Market Report. Food and Agriculture Organization of the United Nations, GLOBEFISH Report, Rome, Italy.

Kastens, T.L. and Brester, G.W. (1996). Model Selection and Forecasting Ability of Theory-Constrained Food Demand Systems. *American Journal of Agricultural Economics* 2: 301-312.

Kmenta, J. (1986). *Elements of Econometrics,* 2nd edition. New York, New York: Macmillan Publishing Company.

Laitinen, K. (1980). *The Theory of the Multiproduct Firm*. New York, New York: North-Holland Publishing Company.

Murphy, E., Norwood, B. and Wohlgenant, M. (2004). Do Economic Restrictions Improve Forecasts? *Journal of Agricultural and Applied Economics* 36: 549-558.

Theil, H. (1980). *The System-Wide Approach to Microeconomics*. Chicago, Illinois: The University of Chicago Press.

Uganda Export Promotion Board. (2005). Uganda: Export Trends by Product, Volume and Value: 1998-2003. Kampala, Uganda. http://www.ugandaexportsonline.com/statistics.htm. Accessed 13 September 2005.

UNCOMTRADE. (2006). United Nations Commodity Trade Statistics Database (UNCOMTRADE). http://unstats.un.org/unsd/comtrade/default.aspx. Accessed 12 December 2006.

Washington, A.A. and Kilmer, R.L. (2002a). The Derived Demand for Imported Cheese in Hong Kong. *International Food and Agribusiness Management Review* 5: 75-86.

Washington, A. A. and Kilmer, R.L. (2002b). The Production Theory Approach to Import Demand Analysis: A Comparison of the Rotterdam Model and the Differential Production Approach. *Journal of Agricultural and Applied Economics* 34: 431-443.