Nile perch demand in the Netherlands: are exports from Kenya, Tanzania and Uganda

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Abstract

This study examined Nile perch demand in the Netherlands and assessed the importance of country of origin as a determining factor. Import demand equations were estimated using the absolute price version of the Rotterdam model where Nile perch fillets were differentiated by product form (chilled and frozen) and by source country (Kenya, Tanzania and Uganda). The Armington framework (source-differentiation) is often used when estimating import demand for a similar product from different sources; however, the results of this study indicated that country of origin is not a factor in the Netherlands when importing Nile perch. Results showed that the responsiveness of importers to price changes was the same regardless to the supplying country. Likelihood ratio tests fail to reject the hypothesis that the own-price and cross-price demand estimates were equal across the three exporting countries. It was also shown that the origin-specific expenditure and own-price elasticities were not significantly different across the three exporting countries.

Keywords: Nile perch; the Netherlands; Rotterdam model; imports; demand; Kenya; Tanzania; Uganda

1.   Introduction

Fish processing/exporting in the countries surrounding Lake Victoria (Kenya, Tanzania and Uganda) is an important source of foreign exchange for local economies. In 2007, total fish exports for the region were valued at US\$344.5 million. Exports for each country were valued at US\$61.2, \$165.6 and \$117.7 million for Kenya, Tanzania and Uganda, respectively. This represented a decrease of 11% when compared to the previous year, but an overall increase of 57% since 2001 (UNCOMTRADE, 2008). The growth in fish exports has particularly impacted Uganda, where fish is currently the highest foreign exchange earner next to coffee, employs approximately 300,000 people, and is the main source of household income for over a million people (Abila, 2000; Nunan, 2007).

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Processed Nile perch (chilled and frozen fillets) is the primary fish export for the Lake Victoria region. Nile perch was introduced to Lake Victoria in the late 1950s and early 1960s and has been the subject of controversy due to the 200 indigenous fish species becoming extinct as a result of the Nile perch's predatory nature. Ecological impacts aside, the introduction of the Nile perch resulted in unprecedented catches, stimulated commercial fisheries and increased socio-economic benefits for the people in the riparian states (Pringle, 2005; Ntiba *et al.*, 2001). In 1982, Nile perch landings were approximately 25,000 metric tonnes, by 2000, total catches for Kenya, Tanzania and Uganda combined were estimated at 220,000 metric tonnes and valued at US$280 to US$400 million annually (Thorpe & Bennett, 2004).

A significant percent of processed fish from Lake Victoria is exported to European markets, particularly chilled Nile perch fillets. According to Josupeit (2005), the European Union (EU) imports from 600 to 800 metric tonnes of chilled Nile perch fillets per week. The Netherlands is a particularly important market because it accounts for a significant percent of Nile perch exported to the EU, and ranks high among Nile perch importing countries in the world (FAO, 2006). In 2007, EU fillet imports (chilled and frozen) from Lake Victoria were valued at US$312.5, of which the Netherlands accounted for 17% (US$52.6 million). In 2001, the Netherlands accounted for 32% of EU frozen fillet imports from Lake Victoria, and has accounted for 18 to 20% in recent years. For chilled fillet imports, the Netherlands has accounted for as much as 31% in 2003, and has accounted for 17 to 24% in the last four years (UNCOMTRADE, 2008).

While the Netherlands is the primary EU market for Nile perch in terms of imports, according to the FAO (2006), Spain in the primary EU market in terms of consumption, followed by France and Italy. However, the Nile perch consumed in these countries enters through the Netherlands where imports are recorded at the point of entry. It has only been in more recent years that France and Italy have imported directly from the Lake Victoria region; however, the main Nile perch dealers are based in the Netherlands and act as intermediaries for the EU (FAO, 2006).

Given the importance of the Netherlands to Lake Victoria fish trade, this study examines Nile perch demand in the Netherlands and assesses the importance of country of origin as a determining factor. Following Seale *et al.* (1992), Winters and Brenton (1993), Muhammad (2007), and Mutondo and Henneberry (2007), import demand equations are estimated using the absolute price version of the Rotterdam model (Theil, 1980) where Nile perch fillets are differentiated by product form (chilled and frozen) and by source country

(Kenya, Tanzania and Uganda). Muhammad (2007) is the only study to consider the demand for Lake Victoria fish in the EU; however, the EU was treated as a single entity in this study, thus ignoring the differences in importer behaviour across EU countries. For instance, the demand for Nile perch in France, which is mostly final demand, could be different from the intermediate demand in the Netherlands.

There are a number of reasons for source-differentiation. Similar products from different sources may be physically different, but more often than not there are perceived differences, such as a country's reputation for a quality product, trade history, reliability and consistency, and political issues tied to trade that give rise to differences that are not explained by product attributes alone (Zhou & Novakovic, 1996). This is particularly the case for intermediate demand since the regulatory issues or unreliability of one exporting country may result in an importing firm willing to pay more for the same product from another country.

While the Armington (1969) framework is typical for most import demand studies, it may not apply to Nile perch demand in the Netherlands. It may be that importers regard Nile perch as homogeneous across source countries. Likelihood ratio tests are used to determine if source-differentiation is valid in this context. In addition, import demand elasticities are derived from an unrestricted model and are statistically compared across the three exporting countries. The results are used to determine if there exists any difference in importer responsiveness due to the supplying country. For instance, do changes in expenditure and prices invoke a different response when importing from Kenya as oppose to Tanzania or Uganda?

2.   Import demand model

The absolute price version of the Rotterdam model (Theil, 1980) has been used quite extensively in import allocation modelling (See the introduction for past studies.). An often overlooked benefit of using the Rotterdam is that regardless to demand being intermediate or final, the empirical specification in the same (Theil, 1980). This is particularly important because it could be argued that Nile perch demand in the Netherlands is intermediate demand.

The Armington framework implies that Nile perch be treated as a product group, and Kenyan, Tanzanian and Ugandan Nile perch be treated as individual goods (within the group) that are imperfect substitutes due to origin-specific factors. To derive the empirical model, we can assume a multistage budgeting process where consumers first allocate expenditures

across products groups and then allocate expenditures across goods within products groups (Seale *et al.*, 1992). From a firm perspective, we can assume an input requirement set (which includes the imports from each country); import demand would simply be the firm's demand for a subset of inputs (Washington & Kilmer, 2002). Given the appropriate separability assumptions, an import demand system limited to Nile perch imports can be specified with either approach.

Assume that Nile perch fillets are disaggregated by product form (chilled and frozen) and source country (Kenya, Tanzania and Uganda). Let *q* and *p* represent the quantity and price of imported Nile perch. Let *i* and *j* denote the product origin where *i* and *j*∈ {Kenya, Tanzania, Uganda}, and *s* and *z* denote fresh and frozen, respectively. Following the notation of Mutondo and Henneberry (2007), the import demand for fresh and frozen Nile perch fillets is respectively specified as follows:

$$
w'_{i_s,t}\Delta q_{i_s,t} = \theta_{i_s}\Delta Q_t + \sum_{j=1}^{3}\pi_{i_s j_s}\Delta p_{j_s t} + \sum_{j=1}^{3}\pi_{i_s j_z}\Delta p_{j_z t} + \xi_{i_s,t}
$$
$$
w'_{i_z,t}\Delta q_{i_z,t} = \theta_{i_z}\Delta Q_t + \sum_{j=1}^{3}\pi_{i_z j_s}\Delta p_{j_s t} + \sum_{j=1}^{3}\pi_{i_z j_z}\Delta p_{j_z t} + \xi_{i_z,t}
$$

$$(1)$$

$w'_t = 0.5(w_t + w_{t\text{-}12})$ is the conditional budget share averaged over the periods *t* and *t*-12 where

$$
w_{i_s} = \frac{p_{i_s}q_{i_s}}{\sum_i p_{i_s}q_{i_s} + \sum_i p_{i_z}q_{i_z}} \quad \text{and} \quad w_{i_z} = \frac{p_{i_z}q_{i_z}}{\sum_i p_{i_s}q_{i_s} + \sum_i p_{i_z}q_{i_z}},
$$

which are the conditional budget shares for the *i*th fresh and frozen imports, respectively. Δ is the log-change operator where for any *q* and *p*, $\Delta q_t = \ln(q_t)-\ln(q_{t\text{-}12})$ and $\Delta p_t = \ln(p_t)-\ln(p_{t\text{-}12})$. Give that monthly data is used for estimation, the twelfth-difference is used to correct for seasonal variation (Duffy, 1990). θ_i is the marginal expenditure share for the *i*th import where

$$
\theta_{i_s} = \frac{\partial(p_{i_s}q_{i_s})}{\partial\left(\sum_i p_{i_s}q_{i_s} + \sum_i p_{i_z}q_{i_z}\right)}.
$$

ΔQ_t is the finite version of the Divisia volume index where

$$
\Delta Q_t = \sum_i w'_{i_s,t}Dq_{i_s,t} + \sum_i w'_{i_z,t}Dq_{i_z,t}.
$$

The Divisia volume index is a measure of change in total Nile perch expenditures (in real terms). $\pi_{i_s j_z}$ is the Slutsky price coefficient which measures the impact of the price of frozen import j on chilled import i. The θ's and π's are assumed constant for estimation, and ξ is a disturbance term that follows a first-order autoregressive process, $\xi_t = \rho \xi_{t-1} + \mu_t$.

The Rotterdam model requires that the following parameter restrictions be met in order to conform to economics theory:

$$\sum_i \theta_{i_s} + \sum_i \theta_{i_z} = 1 \text{ and } \sum_i \pi_{i_s j_s} + \sum_i \pi_{i_z j_s} = 0 \text{ (adding up)},$$

$$\sum_j \pi_{i_s j_s} + \sum_j \pi_{i_s j_z} = 0 \text{ (homogeneity)},$$

$$\pi_{i_s j_s} = \pi_{j_s i_s}, \ \pi_{i_z j_z} = \pi_{j_z i_z} \text{ and } \pi_{i_s j_z} = \pi_{j_z i_s} \text{ (symmetry)}.$$

The Rotterdam model satisfies adding up by construction. Homogeneity and symmetry are imposed on model estimates and statistically tested.

3. Data and descriptive statistics

Monthly data were used for estimating Nile perch demand in the Netherlands and the time period for the data was from January 2001 through September 2008 (93 observations). The External Trade Section of the Statistical Office of the European Communities (Eurostat) provided the data which was the 1995 Standard International Trade Classifications (SITC) 03440 (fish fillets, frozen) and 03451 (fish fillets and other fish meat, fresh or chilled) (Eurostat, 2008). For Lake Victoria, these classifications are mostly Nile perch and to a much lesser degree, Nile tilapia. Imported quantities were measured in units of 100 kg, and values were in euros. Import values were on a cost, insurance and freight (CIF) basis. The source (exporting) countries were Kenya, Tanzania and Uganda. Import prices were calculated by dividing the value of the commodity by the quantity, which resulted in a euro per 100 kg unit of measurement.

In the Netherlands, chilled imports from Lake Victoria have been significantly greater than frozen imports. For instance, in 2007, chilled imports were valued at US$43.0 million, while frozen imports were valued at only US$9.6 million. Additionally, frozen imports were not consistent throughout the data period resulting in a number of zero observations, particularly for Kenya and Uganda. Given that the Rotterdam model is a log-differenced model, zero observations are problematic. Aggregating frozen imports across the three exporting countries solved this problem; however, this negated any analysis of cross country differences in frozen demand. Consequently, the importance of source-differentiation was assessed for chilled imports only.

Letting the subscripts *i* and *j* denote chilled fillets from Kenya (*K*), Tanzania (*T*) and Uganda (*U*), or frozen Nile perch fillets (*Z*), the import demand system with source-aggregated frozen fillets is specified as (the time subscripts are omitted)

$$w'_i \Delta q_i = \theta_i \Delta Q + \pi_{iK} \Delta p_K + \pi_{iT} \Delta p_T + \pi_{iU} \Delta p_U + \pi_{iZ} \Delta p_Z + \xi_i . \qquad (2)$$

Note that when *i* = *K* (for example), the above specification indicates that the demand for chilled fillets from Kenya is a function of total expenditures (ΔQ), own price (p_K), the price of chilled fillets from Tanzania (p_T) and Uganda (p_U), and the weighted average price of frozen fillet imports (p_Z).

Descriptive statistics for the model variables are reported in Table 1. Mean chilled fillet prices were similar for the three exporting countries (€427.42/ 100 kg to €423.76/100 kg). Standard deviations, minimum and maximum values were close as well. The price similarity across the exporting countries suggests that chilled Nile perch fillets could be homogeneous across sources. Given that frozen Nile perch is considered relatively less valuable, its price was significantly lower (€324.96/100 kg). Although chilled fillet prices were similar across the source countries, the mean imported quantities differed significantly. Tanzania is the leading exporter of chilled Nile perch to the Netherlands with mean exports (monthly) at 520 000 kg. Imports from Kenya and Uganda were significant lower at 137 000 and 122 000 kg, respectively. The tendency for the Netherlands to import from Tanzania is also reflected by the mean budget shares where Kenya, Tanzania and Uganda accounted for 14.26%, 51.48% and 12.90% of total import expenditures, respectively. Frozen fillets accounted for 21.37% of total expenditures.

Table 1:   Nile perch imports in the Netherlands: January 2001 – September 2008

Country/Product	Mean	Standard deviation	Minimum	Maximum
price (euros per 100 kg)				
Kenya	427.42	79.32	300.49	641.84
Tanzania	423.76	70.78	302.57	636.22
Uganda	427.18	75.71	264.54	600.95
Frozen fillets	324.96	44.12	238.36	412.63
monthly quantity (100 kg)				
Kenya	1,373.61	667.91	50.00	3,420.00
Tanzania	5,201.40	1,998.90	420.00	9,029.00
Uganda	1,219.37	768.11	17.00	3,856.00
Frozen fillets	2,685.54	1,023.74	743.00	5,060.00
expenditure/budget shares (percent)				
Kenya	14.26	6.83	0.56	31.11
Tanzania	51.48	14.70	5.24	72.86
Uganda	12.90	9.12	0.20	55.62
Frozen fillets	21.37	8.27	7.56	52.09

4.   Empirical results

The import demand equations represented by equation (2) were estimated jointly by maximum likelihood (ML) using the LSQ procedures in TSP (version 5.0). Likelihood ratio (LR) tests were used to test for AR(1), homogeneity, symmetry, identical expenditure effects, identical own-price effects, and identical cross-price effects. The LR test statistic is defined as

$$LR = -2[L_r - L_{ur}] \sim \chi^2_{(k)}.$$

L denotes the log likelihood values for the restricted (r) and unrestricted (ur) models, and k is the number of restricted parameters. LR is distributed χ^2 with k degrees of freedom.

AR(1) was imposed on the error structure using the ML procedure for singular demand systems found in Beach and MacKinnon (1979). The homogeneity condition implied the following restriction on parameters:

$$\pi_{iK} + \pi_{iT} + \pi_{iU} + \pi_{iZ} = 0; \text{ for all } i \in \{K, T, U, Z\}.$$

The symmetry condition implied that $\pi_{ij} = \pi_{ji}$ for all i or j when $i \neq j$. Identical expenditure effects across the exporting countries implied the following restriction: $\theta_K = \theta_T = \theta_U$; identical own-price effects implied: $\pi_{KK} = \pi_{TT} = \pi_{UU}$; and identical cross-price effects implied: $\pi_{KT} = \pi_{KU} = \pi_{TU}$.[2]

For each set of restrictions, the log likelihood values, LR test statistics, and p-values are reported in Table 2. The LR test statistic for no-AR(1) disturbances (69.86) indicated that AR(1) should not be rejected. The test results also indicated that homogeneity and symmetry should not be rejected. Given these results, all subsequent tests are based on imposing additional restrictions on the homogeneity and symmetry constrained model with AR(1) disturbances.

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[2] *The symmetry property ensures that $\pi_{KT} = \pi_{KT}$; $\pi_{KU} = \pi_{UK}$; and $\pi_{TU} = \pi_{UT}$.*

Table 2:   Likelihood ratio tests results

Model	Log-likelihood value	$-2[L_r - L_{ur}] \sim \chi^2$	P-value
AR(1) (unrestricted model)	229.84		
no AR(1) (unrestricted model)	194.91	69.86(1)[a]	0.000
homogeneity	229.27	0.76(3)	0.764
homogeneity & symmetry	226.10	6.33(3)	0.096
identical marginal effects	216.51	19.17(2)	0.000
identical own-price	223.96	4.28(2)	0.118
identical cross-price	223.59	5.02(2)	0.081
identical own & cross-price	221.54	4.84(2)	0.088

[a] *The number of parameter restrictions is in parenthesis*

The LR test statistic for identical marginal shares (expenditure effects) across the three exporting countries was 19.17. This statistic was greater than the χ^2 critical value (5%; $k = 2$) of 5.99. Thus, we can reject the hypothesis that the responsiveness of imports to changes in total expenditures is the same for Kenya, Tanzania and Uganda. This was to be expected given the significant differences in the mean expenditure shares across the three exporting countries. However, the LR test statistics for identical own-price effects and cross-price effects were 4.28 and 5.02, respectively. Both were smaller than the 5% critical value, 5.99. Therefore, these hypotheses should not be rejected suggesting that the responsiveness of imports to changes in the price is not unique to the country of origin. In testing identical own and cross-price effects jointly, this hypothesis also failed to be rejected which is further evidence that origin is not a factor given changes in price.

Estimates of Nile perch demand in the Netherlands are presented in Table 3. The results have AR(1), homogeneity and symmetry imposed, but the price effects are not restricted equal across the exporting countries.[3] Estimates of the marginal expenditure shares (θ) indicated a positive and significant relationship between each import/product and the Divisia index (real expenditures). These estimates measure the responsiveness of a given import to a one-euro increase in total Nile perch expenditures. The marginal share was greatest for chilled fillets from Tanzania (0.563) and significantly smaller for chilled fillets from Kenya and Uganda (0.096 and 0.160, respectively). The marginal share for frozen fillets was 0.181.

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[3] *The restricted own-price and cross-price effects are reported in the table notes. The unrestricted estimates are used to derive price and expenditure elasticities, which are compared across countries for statistical difference.*

With the exception of frozen fillets, the own-price estimates (presented along the diagonal in Table 3) were all negative and significant for all imports. The own-price effect was largest (in absolute value) for chilled Nile perch from Tanzania (-0.529). The own-price effects for Kenya and Uganda were smaller in absolute terms (-0.201 and -0.147, respectively). When all price effects were restricted equal across the three exporting countries, the own-price effect was -0.135 which was significant at the 0.05 level. The cross-price estimates were mostly insignificant and indicated a significant competitive relationship between chilled Nile perch from Kenya and Tanzania (0.329), and a complementary relationship between Kenyan chilled and frozen Nile perch (-0.183). Assuming equal cross-price effects across the exporting countries, the restricted cross-price effect for chilled imports was 0.091 and the restricted cross-price effect with respect to frozen prices was -0.041. Both were significant at the 0.01 and 0.10 levels, respectively.

Table 3:   **Conditional Nile perch demand estimates for the Netherlands**

Country/ Products	Price coefficients π				Marginal share θ	
	Kenya	Tanzania	Uganda	Frozen		
Kenya	-0.201** (0.086)[a]	0.329*** (0.099)	0.055 (0.061)	-0.183*** (0.059)	0.096** (0.041)	R^2 = 0.18 DW = 2.40
Tanzania		-0.529*** (0.179)	0.087 (0.091)	0.113 (0.095)	0.563*** (0.072)	R^2 = 0.49 DW = 2.45
Uganda	Symmetry		-0.147* (0.087)	0.005 (0.066)	0.160*** (0.041)	R^2 = 0.22 DW = 1.83
Frozen				0.066 (0.083)	0.181*** (0.044)	R^2 = 0.16 DW = 2.59

System R^2 = 0.65
Restricted chilled own-price effect = -0.135(0.058)**
Restricted chilled/chilled cross-price effect = 0.091(0.030)***
Restricted chilled/frozen cross-price effect = -0.047(0.026)*
AR(1) parameter ρ =0.659
[a] Asymptotic standard errors are in parentheses. Homogeneity and symmetry are imposed.
***Significance level = 0.01; **Significance level = 0.05; *Significance level = 0.10.

4.1   Import demand elasticities

From equation (2), the expenditure, compensated own/cross-price and uncompensated own/cross-price elasticities are derived. Using the estimates from (2) and the mean budget shares, these are calculated respectively as

$$\varepsilon_i = \frac{\Delta q_i}{\Delta Q} = \frac{\hat{\theta}_i}{\overline{w}'_i} \tag{3}$$

$$\eta^*_{ij} = \frac{\Delta q_i}{\Delta p_j} = \frac{\hat{\pi}_{ij}}{\overline{w}'_i} \tag{4}$$

$$\eta_{ij} = \frac{\Delta q_i}{\Delta p_j} = \frac{\hat{\pi}_{ij}}{\overline{w}'_i} - \frac{\overline{w}'_j}{\overline{w}'_i}\hat{\theta}_i. \tag{5}$$

The compensated price elasticity η^* only accounts for the substitution effect of a price change, while the uncompensated price elasticity η accounts for both the income and substitution effect.

The expenditure and price elasticities (evaluated at mean budget shares) and their asymptotic standard errors were calculated using the ANALYZ procedure in TSP. The ANALYZ procedure uses the delta method to calculate standard errors to determine significance (Hall & Cummins, 2005: 35-40). The expenditure and own- price elasticity estimates are presented in Table 4. Imports from Uganda were the most responsive to expenditures where an expenditure increase of one percent caused imports from Uganda to rise by 1.370%. Imports from Tanzania were also highly responsive to changes in expenditures (1.060%) whereas the imports from Kenya were not as responsive (0.687%). Frozen imports increased by 0.852% given a percentage increase in expenditures.

Table 4: Expenditure and own-price elasticities

Country/Product	Expenditure		Own-price compensated		Own-price uncompensated	
Kenya	0.687	(0.295)[a]**	-1.440	(0.615)**	-1.536	(0.626)**
Tanzania	1.060	(0.135)***	-0.996	(0.337)***	-1.560	(0.336)***
Uganda	1.370	(0.349)***	-1.259	(0.743)*	-1.418	(0.742)*
Frozen	0.852	(0.206)***	0.308	(0.390)	0.308	(0.390)
[a] *Asymptotic standard errors are in parentheses.* ***Significance level = 0.01; **Significance level = 0.05; *Significance level = 0.10.*						

The compensated own-price elasticities indicate that the demand for Kenyan and Ugandan Nile perch was highly responsive to own-price changes where percentage increases in own-price caused chilled imports from Kenya and Uganda to decrease by 1.440% and 1.259%, respectively. The demand for Tanzania fillets was unit elastic (0.996%). Unlike the uncompensated elasticity, these elasticities do not account for the total effect of a change in price, only the substitution effect. The uncompensated own-price elasticities indicate that demand for chilled Nile perch was highly elastic for all three countries where percentage increases in own-price caused imports from Kenya to decrease by 1.536%, Tanzania 1.560%, and Uganda 1.418%. These estimates suggest that Nile perch exporters in Kenya, Tanzania and Uganda could increase revenue by decreasing prices.

The cross-price elasticities, reported in Table 5, were for the most part insignificant. The only significant relationship occurred between Kenya and Tanzania, and Kenya and frozen fillets. Imports from Kenya were more sensitive to price changes in Tanzania (1.997) than imports from Tanzania to price changes in Kenya (0.472). The same was true for the relationship between Kenyan chilled fillets and frozen fillets where a percentage increase in Kenyan prices caused frozen imports to decrease by 0.978%, but a percentage increase in frozen prices caused chilled imports from Kenya to decrease by 1.461%.

LR tests indicated that the price effects were not different across the three exporting countries. However, if the price effects are not restricted, are the resulting elasticities statistically different? Pair-wise comparisons of elasticity values are simply linear combinations of the model estimates. For instance, a pair-wise comparison of the expenditure elasticities for the ith and jth exporting countries is as follows:

$$\hat{d}_{ij} = \varepsilon_i - \varepsilon_j = \frac{\hat{\theta}_i}{\overline{w}_i'} - \frac{\hat{\theta}_j}{\overline{w}_j'} \; .$$

Table 5:   Cross-price elasticities

Quantity/Price	Compensated		Uncompensated	
Kenya/Tanzania	2.362	(0.713)a***	1.997	(0.702)***
Kenya/Uganda	0.393	(0.436)	0.313	(0.436)
Kenya/Frozen	-1.314	(0.427)***	-1.461	(0.432)***
Tanzania/Kenya	0.620	(0.187)***	0.472	(0.191)**
Tanzania/Uganda	0.164	(0.172)	0.041	(0.173)
Tanzania/Frozen	0.213	(0.179)	-0.013	(0.182)
Uganda/Kenya	0.470	(0.522)	0.279	(0.532)
Uganda/Tanzania	0.749	(0.785)	0.021	(0.790)
Uganda/Frozen	0.040	(0.569)	-0.252	(0.577)
Frozen/Kenya	-0.860	(0.279)***	-0.978	(0.285)***
Frozen/Tanzania	0.530	(0.445)	0.078	(0.448)
Frozen/Uganda	0.022	(0.311)	-0.078	(0.311)
a Asymptotic standard errors are in parentheses. ***Significance level = 0.01; **Significance level = 0.05;*				

The test for determining if elasticities are significantly different from each other is equivalent to testing the significance of d_{ij} (i.e. H$_0$: $d_{ij} = 0$). Defining the standard error of d_{ij} as $se(d_{ij})$, a t-test statistic for the null hypothesis is defined as $d_{ij}/se(d_{ij})$ (Green, 1997: 336).

Table 6 gives the pair-wise difference estimates (d_{ij}) and their standard errors $se(d_{ij})$. Also reported are the t-statistics and p-values for testing the null (d_{ij} = 0). The asymptotic standard errors of the difference estimates were calculated using the ANALYZ procedure in TSP. Given that the standard errors are asymptotic, the critical value for each test is 1.96 ($df = \infty$). Therefore, we fail to reject the null if the test statistic is less than 1.96.

The test results show that the difference estimates were not statistically different from zero which implies that there was no statistical difference in the expenditure and own-price elasticities across the exporting countries. This was the case for all pair-wise comparisons (Kenya and Tanzania, Kenya and Uganda, or Tanzania and Uganda) of the expenditure elasticities, and compensated and uncompensated own-price elasticities. For instance, in comparing the compensated own-price elasticities for Kenya and Tanzania, the difference between the own-price elasticities was -0.444, and the standard error of this difference was 0.590. This resulted in a test statistic of -0.752 which was less than the 5% critical value (1.96) in absolute value. Thus, we can conclude that the difference estimate is not significantly different from zero and that the two elasticities are statically equal. Overall, the test results implied that the responsiveness (in percent) of Nile perch importers to changes in expenditures and prices was independent of the country of origin. This is further evidence that origin may not be a factor.

Table 6: **Hypothesis tests for significant difference in elasticities across countries**

Expenditure	Difference estimate(d_{ij})*	t-statistic	P-value	Test Result
Kenya = Tanzania	-0.374 (0.384)	-0.972	[0.331]	Fail to reject
Kenya = Uganda	-0.683 (0.478)	-1.430	[0.153]	Fail to reject
Tanzania = Uganda	-0.309 (0.437)	-0.708	[0.479]	Fail to reject
Compensated own-price				
Kenya = Tanzania	-0.444 (0.590)	-0.752	[0.452]	Fail to reject
Kenya = Uganda	-0.182 (0.960)	-0.189	[0.850]	Fail to reject
Tanzania = Uganda	0.262 (0.761)	0.344	[0.731]	Fail to reject
Uncompensated own-price				
Kenya = Tanzania	0.024 (0.610)	0.039	[0.969]	Fail to reject
Kenya = Uganda	-0.118 (0.967)	-0.122	[0.903]	Fail to reject
Tanzania = Uganda	-0.142 (0.760)	-0.186	[0.852]	Fail to reject
* Asymptotic standard errors are in parentheses. The 5% critical value for each t-test is 1.96.				

4.2   Why is country of origin not a factor?

There are number of factors to consider in explaining why country of origin may not be a factor in Nile perch trade. On the supply side, there is the obvious fact that all three countries share the primary source of Nile perch, Lake Victoria, and there is no reason to believe that differences exist in the Lake's ecosystem specific to international boundaries. Additionally, the activities surrounding the Lake are not specific to any one country because each country is affected by the behaviour of its riparian neighbours. At times there have been differences in fishing practices across the three countries, for instance, Uganda completely banned industrial fishing techniques before Kenya and Tanzania, but this was more an issue of sustainability which has been a concern for all three countries. Essentially, there has been great effort to differentiate Nile perch as a Lake Victoria product relative to white fish exports from Asia and other exporting countries. There is little evidence to suggest that processors, exporters and importers (middlemen) engage in practices to differentiate Nile perch by exporting country.

Regarding issues of quality and production practices, quality assurance standards have been implemented across the three riparian countries, particularly since the EU imposed import bans on fish from the Lake Victoria region during the years 1997-2000. The first and second bans were due to the Spanish Veterinary Authority detecting salmonella microbes in Lake Victoria fish. The third ban was the result of fisherman using pesticides and chemicals to intoxicate fish to increase catches (Dijkstra, 2001). Much of the capital in the fisheries sector went unused during this period causing prices and industry output to decline significantly (Marriott *et al.*, 2004). Thorpe and Bennett (2004) noted that these bans helped in making participants in the supply chain aware of the importance of employing harvesting and production practices in compliance with international standards and the desires of European consumers.

In response to the EU bans, improvements in production and sustainability practices appear to have been a coordinated effort between the three countries. For instance, the Lake Victoria Environmental Management Project, implemented by the World Bank and developed to tackle environmental issues afflicting Lake Victoria, included all three countries. The three riparian countries, under the auspices of the East African Community, also formed the Lake Victoria Fisheries Organization in 1994 in order to coordinate the management and conservation of the lake and its basin (Njiru *et al.*, 2008). More recently, there has been interest in establishing an eco-label for Nile perch to certify that production is ecological and socially compatible. All three

countries appear to be in agreement with eco-labelling which could differentiate Nile perch internationally from cheaper imports from other countries (Scholz, 2007).

On the demand side, Nile perch is marketed in the EU as a product of Lake Victoria. The particular exporting country does not appear to be a factor. Keizire (2006) notes that preferences in European markets are fairly homogeneous where European consumers prefer skinless fillets of sizes 200g to 500g as oppose to Japan, the Middle East and Hong Kong where fillets from larger fish are more acceptable. This suggests that the potential for product specialisation specific to a particular to specific EU markets is limited.

Lastly, Anova Food, which is located in the Netherlands, is one of the largest distributors of Nile perch in the EU. Imports from Lake Victoria are facilitated by their African affiliate, Anova East Africa Limited, which is located in Kenya. Particularly revealing is Anova's informational brochure which is intended for retail and food service outlets in the EU (see www.anovafood.com). There is no mention of the exporting countries in the brochure, nor is there any mention of Africa. Interestingly, Nile perch is marketed as "Lake Victoria Perch" where the descriptive "Nile" is never used. This is some indication that origin is not an issue for EU consumers and modifiers such as "Ugandan", "Tanzanian" or "Nile" offer no benefit in sales.

5.   Summary and conclusion

This study examined Nile perch demand in the Netherlands and assessed the importance of country of origin as a determining factor. Import demand equations were estimated using the absolute price version of the Rotterdam model where Nile perch fillets were assumed differentiated by product form (chilled and frozen) and by source country (Kenya, Tanzania and Uganda). Overall, it was determined that source was not important in determining the behaviour of Nile perch importers in the Netherlands. The results showed that the importer response to changes in prices and expenditures did not vary with the exporting country. LR tests fail to reject the hypothesis that the own-price and cross-price estimates were equal across the three countries. It was further shown that even when the price estimates were not restricted, the expenditure and own-price elasticities were not significantly different across the three exporting countries.

The implications of this study are straightforward. There are no origin-specific factors that give one Lake Victoria country advantage over the other in the Netherlands. Given percentage changes in total import expenditures, the

percentage changes in chilled Nile perch imports by country would be the same. Thus, no country could expect to benefit more so than the other given rising expenditures in the Netherlands (percentage wise). Likewise, no one country would be more disadvantaged given a decline in total expenditures. Although there was no difference in the own-price elasticities across the exporting countries, the demand for Nile perch was elastic. This suggests that a decrease in price would lead to an increase in export revenue for Kenya, Tanzania and Uganda.

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