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TRADE POLICY CHANGE AND PRICE VOLATILITY SPILL-OVER IN A CUSTOMS UNION: A CASE STUDY OF LAMB TRADE BETWEEN NAMIBIA AND SOUTH AFRICA

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Abstract

Namibia introduced the "Small Stock Marketing Scheme" (SSMS) in 2004 which replaced 15% export duty on live sheep exports to South Africa with progressively demanding quantitative restrictions. This policy increased price volatility in the Namibian sheep market. We used relevant monthly price data and employed EGARCH modeling to determine if price volatility spilled-over from the sheep market in Namibia to South African sheep market. About 71 percent of the volatility in the Namibian sheep market is transmitted to the retail market in South Africa and the transmitted volatility remains persistent.

Key Words: *Small Stock Marketing Scheme, Lamb Trade, Volatility Spill-Over, Persistence, EGARCH.*

1. Introduction

Namibia and South Africa are both members of the Southern African Customs Union (SACU), originally established on June 29, 1910. It is the oldest Customs Union in the world. After Botswana, Lesotho and Swaziland (BLS) gained independence from Britain in mid 1960s, they renegotiated SACU with the government of South Africa in 1969. The new agreement included a revenue-sharing formula to distribute total customs and excise revenues collected among its members. The governments of BLS received a significant share of their revenue through this arrangement. Namibia was a *de facto* member of SACU from 1910 as it was part of South Africa known as the Western Africa at that time. However, after independence, Namibia became a member of SACU formally in 1990.

BLS were concerned since 1969 that SACU was not particularly responsive to their needs and that the benefits were not equitably distributed. While numerous issues related to these concerns were brought into many rounds of discussion since the mid-1970s, no satisfactory resolution to them was reached before the 1990s. After the formation of the first South African government of national unity, South Africa initiated formal negotiations with Botswana, Lesotho, Namibia and Swaziland (BLNS) for a new SACU in November 1994. After more than eight years of on and off negotiations, the current SACU emerged with a new revenue-sharing formula, new institutional details and a revised governance structure. The agreement signed in October 2002 allows tariff revenues to be shared among members more equitably than before. In recent years, this revenue has contributed to about

70% of the annual budgets of Swaziland and Lesotho and about 30% of the annual budget of Namibia (WTO, 2003; Taljaard *et al*., 2009).

Namibia is located to the North-West of and shares a long border with South Africa. Agro-ecological and climatic conditions in Namibia are more suitable for animal production than growing crops. Namibia is a surplus producer of mutton and lamb, and has been exporting live sheep and mutton long before the country gained independence from South Africa. On the other hand, domestic production satisfies only about 65% of total mutton consumption in South Africa. Therefore, South Africa has been a net importer of mutton from Namibia. Geographical proximity and the SACU make South Africa the most preferred export destination for Namibian mutton and lamb. In recent years, about 80% of the sheep raised in Namibia have been exported live to and slaughtered in South Africa.

In an effort to stimulate value addition in Namibia, based on the strategies of the "Vision 2030" which called for new initiatives for employment creation, capacity utilization, income generation and export earnings, Namibian cabinet introduced the so called "Small Stock Marketing Scheme" (SSMS) in November 2003. The SSMS came into effect on July 01, 2004 and replaced 15% export duty on live sheep export to South Africa (PWC, 2007). This program required sheep farmers to slaughter one sheep at one of the designated abattoirs in Namibia for each sheep exported to South Africa. These abattoirs pay local price to the farmer and export the carcasses to South Africa. The ratio implemented through an export permit system was raised subsequently to 2:1 in 2005 and to 6:1 in September 2006. Although the current quota ratio (6:1) was to expire on June 30th, 2008, due to the inability of the government of Namibia to devise an alternative system, the SSMS continues to govern mutton and lamb trade between Namibia and South Africa.

The SSMS substantially reduced the number of live sheep but increased the volume of mutton exported to South Africa. While it is yet to be demonstrated that the SSMS made much progress in achieving the job creation and income generation objectives, it has changed the composition of mutton exported to South Africa. In addition, the program may have affected the nature of price transmission across the border and may have retarded the speed of market integration within the SACU. There is a growing concern in South Africa that the SSMS has increased price volatility in the Namibian market and a significant share of price volatility is being spilled-over from the Namibian sheep market to the sheep market in South Africa. While the transmission of price volatility in vertically or horizontally linked agri-food markets has received considerable attention in recent years and the existence of volatility spill-over in vertically linked commodity markets have been well documented in the literature (Goodwin & Holt, 1999; Haigh & Bryant, 2001; Natcher & Weaver, 1999; Buguk et al., 2003; Rezitis, 2003; Meyer & Von Cramon-Taubadel, 2004 and Frey & Manera, 2007), to the best of our knowledge, no study has been conducted to investigate the volatility spill-over effects in markets that are linked by virtue of a Customs Union. An attempt is made in this article to bridge this gap in the existing literature by focusing on the Southern African Customs Union (SACU).

In a competitive market, for a given level of supply, price at the retail level is determined by consumer demand. Processing, transportation and other marketing costs are used to determine prices at processing level and at farm level. Since the market for live sheep and mutton are vertically linked and prices are also linked at different market levels, it is reasonable to expect that price volatility would also be transmitted between market levels (Haigh & Bryant, 2001). Does price volatility in live sheep market in Namibia spill-over to the retail market for mutton in South Africa and *vice versa*? Thus, the primary objective of this study is to investigate the extent to which price volatility in live sheep market in Namibia spills over into the retail market for mutton in South Africa. The second objective of our study is to examine if the price volatility transmission between these two levels are symmetric or asymmetric. An asymmetric transmission would be indicative of

market power in cross-border trade within a Customs Union (Bailey & Brorsen, 1989; Miller & Hayenga, 2001).

Section two focuses on the origin and developments in SACU. Section three deals with lamb trade between Namibia and South Africa. Section four highlights key econometric issues and describes the data set used. The results from our econometric analysis are discussed in section five. The final section summarizes the main findings and concludes the paper.

2. SACU: Origin and Development

The origin of SACU dates back to the 1889 Customs Union Convention between the British Colony of the Cape of Good Hope and the Orange Free State Boer Republic (Lee, 2003). In 1893, Botswana and Lesotho (known at that time as Bechuanaland and Basutoland respectively), both under the direct administrative control of the British High Commissioner, joined the 1889 Customs Union Convention with significantly diminished rights (Gibb, 1997). In 1903, a new Customs Union Convention was signed between the Cape, Natal, Orange River Colony, Transvaal and Zimbabwe which also included the three High Commission Territories (HCTs are territories directly administered by the British High Commissioner of Africa), Botswana, Lesotho, Swaziland. However, the independence of South Africa from Britain in 1910 led to the termination of all previous customs union arrangements. A new Agreement was negotiated between the British High Commissioner and the new Govt. of South Africa. Thus, the forerunner of the present-day SACU was born in June 1910 (Walters, 1989).

This Agreement introduced free movement of manufactured products among members and established a common external tariff and a revenue sharing formula proportional to the members' external trade during 1907-1910. As a result, South Africa received 98.7 percent of the total customs revenue while the three HCTs together received only 1.3 percent. Although the levels of imports and exports grew over time, the revenue-sharing formula remained unchanged for almost 60 years. Since the HTCs lacked independent administrative structures to govern the Customs Union, a number of asymmetries were built into the 1910 SACU Agreement. For example, only South Africa had the authority to administer the Customs Union, change or revise any policy. Moreover, South Africa received the exclusive right to determine issues related to SACU's external tariff (Walters, 1989; McCarthy, 1992). These two and many other contentious issues put SACU under strain during the first 60 years of its existence. From a geopolitical perspective, the SACU of 1910 grew out of British imperial interest and colonial strategy which did not include the independence of HTCs as a desirable option. Thus, unlike other Customs Union, SACU was not driven by developmental goals; development in the HCTs was not considered beyond resource extraction for overseas markets (Gibb, 2006).

South Africa adopted an import substitution policy in 1925 to promote industrial growth. This policy resulted in high import tariffs for manufactured products imported in SACU which stimulated manufacturing in South Africa but at the expense of the HCTs. It was clear to all members by the early 1960s that the revenue sharing formula needs to be revised. Accordingly, the negotiations started in 1963 and the new SACU took effect on March 1st, 1970 after the independence of the HCTs from Britain. While the new SACU was more detailed and comprehensive than the previous one, South Africa retained the power to determine customs tariffs, rebates, anti-dumping and countervailing duties. Namibia became an official member of SACU after gaining independence from South Africa in 1990.

Table 1. Structural Characteristics of SACU Member States: Selected Years

	South Africa		Botswana		Lesotho		Namibia		Swaziland	
	2004	2010	2004	2010	2004	2010	2004	2010	2004	2010
Area (000sq.km)	1,214.47	1,214.5	566.7	566.7	30.36	30.36	823.3	823.29	17.20	17.20
Population (million)	46.665	49.991	1.852	2.007	2.047	2.171	2.043	2.283	1.016	1.056
GDP (US$ b current)	219.09	363.52	10.05	14.91	1.234	2.179	6.606	11.133	2.421	3.698
GDP / capita (current US$)	4695	7272	5425	7427	603	1004	3233	4876	2382	3503
Share of Agril. (%)	3	2	2	2	10	9	10	8	9	8
Share of Industry (%)	31	31	51	45	32	32	29	20	46	47
Share of Manufac. (%)	19	15	4	4	22	13	14	8	40	42
Share of Services (%)	66	67	47	52	58	60	61	73	45	45

Source: World Bank, World Development Indicators

In early 1990s, SACU was considered as a 'colonial relic', undemocratic and a symbol of South Africa's apartheid legacy. In 1994 the Ministers responsible for SACU met in Pretoria to establish a process for renegotiating the SACU Agreement. They appointed a Customs Union Task Team (CUTT) consisting of senior civil servants from five member states to come up with recommendations by March 1995. After eight years of difficult negotiations, a new SACU Agreement was signed on October 21, 2002 in Gaborone, Botswana. The new SACU is far more comprehensive than the predecessors. It consists of three main sections: (i) institutions and governance, (ii) trade liberalization and regulation, and (iii) revenue sharing. It established six new institutions for different decision making: the Council of Ministers, Customs Union Commission, Secretariat, Tariff Board, Technical Liaison Committees and a Tribunal. In addition, each member state has been granted authority to establish its own "National Body" to deal with tariff and trade remedy issues. The new institutional structure allows each member to participate on an equal basis in SACU (McCarthy 2003, Gibb 2006).

South Africa has been the dominant member of SACU due to its economic size and geographical advantage. The Kingdom of Lesotho is a small land-locked state surrounded by South Africa while Swaziland is land-locked by South Africa and Mozambique and is located to the East of Johannesburg, the largest city in South Africa. Botswana is a relatively large country and is well developed in agriculture and manufacturing. However, depends exclusively on South African ports for foreign trade. Despite being the member of SACU since 1910, the economic management and the overall performance of BLNS countries differ markedly from each other and from those of South Africa (Table 1). In 2010, South Africa occupied only 46 percent of total land area in SACU but had about 87 percent of total population and 92 percent of total GDP (Table 1). While South Africa and Botswana are upper-middle income countries, Namibia and Swaziland are considered middle-income countries and Lesotho is a least developed country (World Trade Organization, 2003).

3. Lamb Trade between Namibia and South Africa[1]

Namibia has been exporting live sheep and mutton to South Africa long before it became independent. The trade in live sheep and mutton between these two neighbouring countries continued unfettered until 2004 when Namibia introduced the "Small Stock Marketing Scheme". Under this scheme, Namibia imposed quantitative restrictions on the export of live sheep to South Africa. Live sheep can enter South Africa freely. However, if animals are to be slaughtered in Namibia, the Meat Safety Act (2000) of South Africa requires that the abattoir facilities in Namibia must be inspected and approved by the Director of Animal Health in South Africa. There are only four such abattoirs in Namibia which can slaughter 5400 sheep per day. The location, ownership and capacity of these abattoirs are presented in Table 2.

Table 2. Location, Ownership and Daily Capacity of Namibian Abattoirs Approved for Export

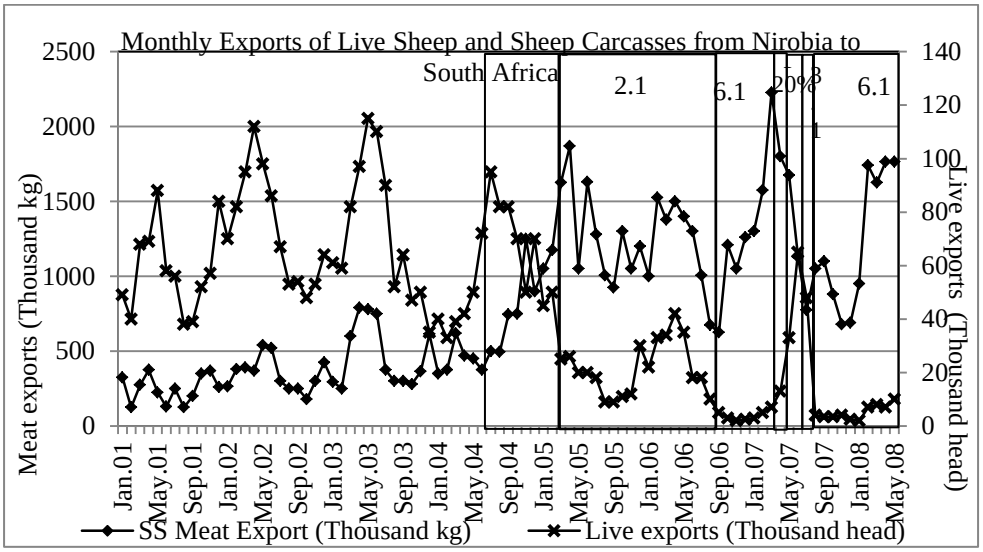
Location	Name	Owned and Operated By	Daily Capacity (Sheep)
Windhoek	Meat Corporation of Namibia	Just Lamb (Pty) Ltd.	1300
Mariental	Farmers' Meat Market	Farmers' Meat Market	1300
Aranos	Natural Namibian Meat Producers	Natural Namibian Meat Producers	1300
Keetmanshoop	Karas Abattoir and Tannery (Pty) Ltd.	Karas Abattoir and Tannery (Pty) Ltd.	1500

Source: Price Waterhouse Coopers (2007)

Since the introduction of the SSMS in July 2004, the number of live sheep exported to South Africa declined sharply while the number of sheep slaughtered at designated abattoirs increased dramatically. The quantitative dimension of these impacts of the SSMS can be gleaned from figure 1 which shows monthly exports of Namibian live sheep and mutton to South Africa from January 2001 to May 2008. Despite considerable month to month fluctuations, it is clear that the exports of lamb carcasses increased significantly from less than 500 thousand tons (on average) from January 2001 to June 2004, to more than 1500 thousand tons (on average) after May 2005. The quantity of mutton exported to South Africa became more variable after the introduction of the SSMS in 2004.

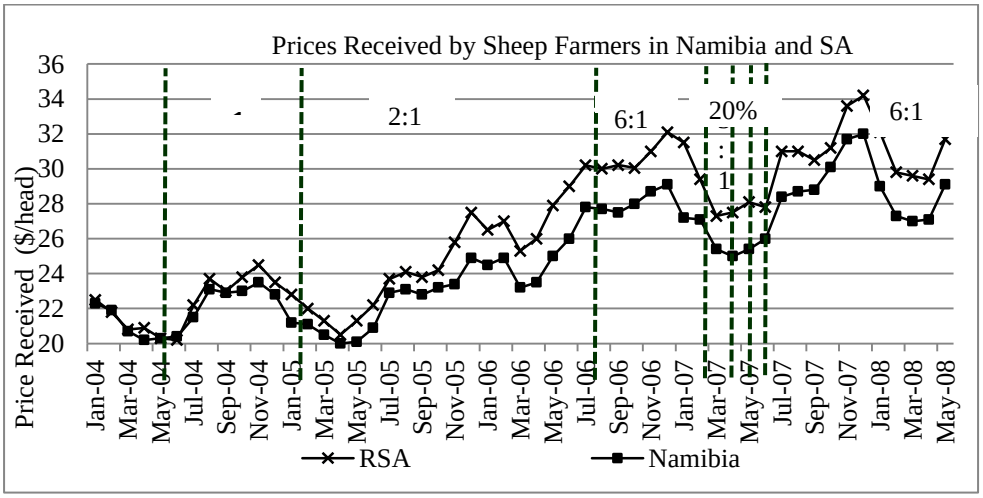
Did the SSMS influence the price received by sheep farmers in Namibia? Economic theory postulates that if an exporting country imposes a quantitative restriction on export, it will depress the price in the domestic market and hurt the primary producers (Houck, 1992). Figure 2 compares the prices received by sheep farmers in Namibia and in South Africa from January 2004 to May 2008. In the past, prices received by Namibian farmers were often higher than those received by farmers in South Africa for a comparable grade (A2). However, after the introduction of the SSMS, price received by Namibian sheep farmers have been consistently lower than the price received by sheep farmers in South Africa. Secondly, sheep prices became more volatile after the introduction of the SSMS than before.

[1] This section draws heavily from Taljaard et al., 2009.



Source: Adapted from Taljaard et al., 2009.

Figure 1. Monthly Exports of Sheep and Sheep Carcasses from Namibia to South Africa



Source: Adapted from Taljaard et al., 2009.

Figure 2. Prices Received by Sheep Farmers in Namibia and South Africa: January 2004-May 2008

4. Econometric Issues and Data

We used monthly data on producer price of sheep in Namibia and the monthly wholesale and retail prices of mutton in South Africa from January 2000 to March 2008.

Producer price of sheep in Namibia was obtained from the Namibian Meat Board while the retail and wholesale prices of mutton in South Africa were obtained from "Statistics South Africa" and the "National Department of Agriculture". The summary statistics of the price variables are presented in Table 3. The skewness and kurtosis measures indicate that all three prices are positively skewed and leptokurtic relative to the normal distribution. However, the J-B normality test suggests that each price still conforms to a normal distribution as it was not possible to reject the null of normality at 5 percent level.

Table 3. Summary Statistics of the Data

	Retail price	Wholesale price	Producer price
Mean	3.4209	3.0753	1.7365
Variance	0.0592	0.0587	0.0591
Skewness	0.1099	0.0607	0.2936
Kurtosis	1.8959	1.8921	3.1189
Jacque-Bera	5.2282 (0.073)	5.1244 (0.077)	1.480 (0.4771)

Previous studies found strong seasonality in price volatility for agri-food commodities (Goodwin & Schnepf, 2000; Buguk et al., 2003) and some argued that seasonally adjusted data should be used for analyzing the effect of price volatility spill-over (Kostov & McErlean, 2004). However, seasonal adjustments can introduce noise in the data and compromise the strength of some stationarity tests (Apergis & Rezitis, 2003). It is still important to know the seasonal pattern in and time-series properties of the data. We tested for the presence of seasonal effects in each series using sixth and twelfth months as base periods. There is no evidence of seasonality but all prices were found to be time-trended.

Since the presence of nonstationarity can complicate the specification and estimation of a GARCH model, we employed the augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979) to determine if each price series is characterized by nonstationarity. The results show that only the retail price characterized by unit roots and it becomes stationary after first-differencing (Table 4). We used data in first-differenced form in our estimation.

Table 4. Time Series Properties of the Price Series Used (ADF Test)

Prices	ADF Test (level form with a trend)	ADF Test (first differenced form)
SAretail	-2.945	-8.6504*
SAproces	-4.179*	-7.9963*
NAMprod	-4.356*	-14.4516*

Note: * indicates rejection of the null hypothesis of unit root at 5 percent level of error probability.

Based on the coefficient of variation (CV), volatility in producer price in Namibia increased from 13.3% to 20.55%. The variability of retail price in South Africa increased from 13.43% to 33.72%, while that of the wholesale price increased from 14.51% to 37.05%. Thus, price volatility increased substantially in both countries after the introduction of the SSMS. The results from the ARCH-LM test demonstrate that there is significant ARCH effect. Thus, the volatility in each price series is time-varying in nature (Table 5). This justifies the use of a GARCH model in this study (Moledina et al., 2004).

Table 5. Results of ARCH-LM Test

Prices	F-statistic	Probability
SAretail (ARCH,1)	6.3716	0.01327*
SAproces(ARCH,1)	10.4588	0.00024*
NAMprod (ARCH,1)	17.3768	0.00007*

Note: *indicates **r**ejection of the null hypothesis of no ARCH effect at 5 percent level of significance.

5. EGARCH Model and Price Volatility Spill-Over

The generalized autoregressive conditional heteroskedasticity (GARCH) model developed by Bollerslev (1986) has been has been the workhorse in financial econometrics. This model has been used by many researchers to model risk-return relationships, price volatility and volatility spill-over in various agricultural and non-agricultural markets. Since its introduction, the GARCH model has also been extended in various directions. The exponential GARCH or the EGARCH represents a popular extension of the GARCH model. Nelson (1991) highlighted three inadequacies of the standard GARCH model. Strict restrictions on parameters are required to ensure positive values of conditional variance at each point. Secondly, the standard GARCH model only allows symmetric response to shocks. Finally, it is difficult to measure persistence of volatility in a standard GARCH model. The modifications to the standard GARCH model introduced by Nelson (1991) led to the development of an EGARCH model. The logarithmic form of the EGARCH model guarantees the non-negativity of the conditional variance without any constraint on the model's coefficients. In this model, only the coefficients of GARCH term govern the persistence of volatility shock. These features motivated us to use the EGARCH model to investigate price volatility persistence and volatility spill-over from Namibian sheep market to South African sheep market.

To specify an appropriate EGARCH model, the lag lengths for p and q need to be determined first (Maddala and Kim, 1998). We employed the Box-Jenkins methodology (Box & Jenkins, 1976) to determine these lag lengths. Based on the results of the Box-Jenkins estimations, all three conditional variance models used in this study were specified as EGARCH (1,1). The mean and variance equations of the EGARCH model are:

$$\gamma_t = \alpha_0 + \sum_{i=1}^{n} \beta_i \gamma_{(t-i)} + D + \varepsilon_t \quad (1)$$

$$\varepsilon_t | \Omega_{t-1} \approx N(0, \sigma_t^2)$$

$$\ln\sigma_t^2 = a_0 + a_1 \left|\frac{\varepsilon_{t-1}}{\sigma_{t-1}}\right| + b_1 ln\sigma_{t-1}^2 + \gamma_1 \left(\frac{\varepsilon_{t-1}}{\sigma_{t-1}}\right) \quad (2)$$

Equation 1 is the conditional mean equation (specified as an autoregressive process of order n), where y_t represents percentage change in price series, D is the deterministic trend variable and, ε_t's are residual from the conditional mean equation and are distributed as normal given the information set, Ω_{t-1}. In the EGARCH (1,1) model specified in equation 2, unconditional variance exists when the process is covariance stationary. This requires that the value of (a_1+b_1) is less than 1 (Teräsvirta, 2009). The persistence of volatility is represented by the coefficient, b_1 (Engle & Bollerslev, 1986). The closer the value of this coefficient to 0, the less persistent is volatility over time. In an efficient market, volatility is expected to dissipate quickly after a shock. Therefore, it is indicative of some sort of inefficiency in the market. Asymmetry is introduced in the conditional variance equation by including the lags of the unconditional normalized standard deviations. A statistically

significant coefficient, γ_1 confirms the presence of asymmetric effect. Thus, negative shocks have an impact of (a_1-γ_1) on the log of the conditional variance. Similarly, positive shocks have an effect of ($a_{1+}\gamma_1$) on the conditional variance (Bettendorf et al., 2009).

Political intervention is a major cause of asymmetric price transmission (APT) in agriculture. When the impact of a policy shock on the price is predominant at one level of the market, it gets transmitted to other levels (Meyer & Von Cramon-Taubadel, 2004). The introduction of the SSMS in Namibia has increased the availability of live sheep to abattoirs in Namibia but there was little change in demand for mutton in the Namibian market. This led to significant drop in sheep price at the farm level (Figures 1 and 2). As there are only four certified abattoirs in Namibia, the processing sector is oligopolistic and this can cause price stickiness at the wholesale level. This in turn, generates an asymmetric response to farm-level price change in Namibia.

Since Namibia only exports sheep and mutton to South Africa, we assume a unidirectional spill-over effect in this study.[2] To capture the volatility spill-over effect, we introduced percentage change in producer price of sheep in Namibia in the mean equation of the retail and wholesale prices and the retail price in the mean equation of the producer price. In addition, the conditional variance equations of retail and wholesale prices are both augmented to include contemporaneous squared residuals from the producer price while that of the producer price is augmented with contemporaneous squared residuals from the wholesale price equation. Existence of volatility spill-over is indicated by the statistical significance of the coefficient of this variable in conditional variance equation in the augmented model. As it is anticipated that there will be possible violation of the normality assumption (i.e. series with fatter or thinner tails than the normal density), the generalized error distribution (GED) based on Nelson (1991) was specified. For any random variable (X_t) to have a GED with zero mean, constant variance and a tail parameter, v, it must satisfy the following condition:

$$g(X_t) = \frac{vexp[-(1/2)|X^t/\phi|^v]}{\emptyset 2^{(v+1)/v} \Gamma(1/v)}$$

Where:
$$\phi = \sqrt{\frac{2^{-2/v}\Gamma(1/v)}{\Gamma(3/v)}} \qquad (3)$$

The probability density function reduces to a standard normal distribution when the GED parameter $(v) = 2$. When $v < 2$, the density has a fatter tail than the normal density; $v > 2$ signifies a thinner tail than the normal density. We expect $v < 2$ in most cases so that the probability density function is fat-tailed.

Maximum likelihood estimation, based on the Berndt-Hall-Hall-Hausman algorithm (Berndt et al., 1974) was used to estimate the parameters of conditional mean and variance equations in E-Views version 4. The estimation results are presented in the following section.

6. Estimation Results

The estimation results of the EGARCH models for retail, wholesale prices for South Africa and producer prices for Namibia are presented in Table 6. In each of the three models, estimated value of b_1 is statistically significant and close to 1. This result demonstrates that price volatility persists for a long period in all three markets following a

[2] While this may appear to be a very strong assumption, it truly represents the trade of sheep and mutton between these two countries.

shock. The volatility persistence is greater (in absolute value) at the farm level in Namibian sheep market than at the wholesale and retail levels in the South Africa. However, price volatility persists more at the retail level than at the wholesale level in South Africa. This evidence suggests that the consumers of mutton in South Africa bear a larger share of the impact of price volatility than the processors.

Table 6. EGARCH Estimation Results for Retail, Wholesale and Producer Prices Meat

Parameter	Retail price (SA)	Wholesale price (SA)	Producer price (NA)
β_1	1.1426**	0.3981**	0.5999**
β_2	-0.3385**	0.1559**	0.2379**
D	0.0082**	-	0.0098**
a_0	-2.4352	-2.7159**	-9.4467**
a_1	0.5605*	-0.1915**	0.2264**
b_1	0.7199**	0.5451**	-0.8993**
γ_1	0.1122	0.5488**	-0.2189*
GED parameter	1.585**	1.6064**	1.0763**
Log-Likelihood	208.2510	181.6306	109.7250
Diagnostics of Standardized and Squared Residuals			
Ljung-Box (12)	7.48	10.75	15.04
	(0.679)	(0.377)	(0.13)
Ljung-Box^2(12)	5.40	14.68	2.96
	(0.863)	(0.144)	(0.98)
Jarque-Bera	6.59	1959.62	64.48
	(0.037)	(0.00)	(0.00)

Note: Single and double asterisks (*) indicate statistical significance at the 0.05 and 0.01 levels respectively. P-values are in parenthesis under diagnostics of standardized and squared residuals.

The asymmetric parameter, γ_1 is significant for both the producer price of sheep in Namibia and the wholesale price of sheep in South Africa (Table 6). The negative sign of this coefficient for the producers' price of sheep in Namibia reflects the impact of the SSMS on sheep prices in Namibia. As the certified abattoirs in Namibia do not have the capacity to handle the policy induced influx of live sheep from farmers, this may have resulted in APT in sheep prices in Namibia. There is no evidence of APT at the retail level in South Africa.

The GED thickness parameters are 1.59, 1.61 and 1.10 for retail and wholesale prices in South Africa and for producer price in Namibia respectively. These results suggest that the underlying distribution of each price series is thicker than the normal distribution. The Jarque-Bera normality test statistics for the three models show that the standardized residuals for the prices series are still not normally distributed. The Ljung-Box statistics for standardized residuals and squared standardized residuals show the adequacy of the EGARCH model used as it explained all linear and non-linear sources of variation in the price series. Finally, except for the conditional variance of retail price, the estimated EGARCH models are covariance stationary (Table 6).

Table 7. EGARCH Estimation Results for Volatility Spill-Over from Namibia to South Africa

Parameter	Retail (SA)	Processing (SA)	Farm (NA)
X	0.2039**	0.7926**	0.3972*
β_1	0.0140	-0.0692**	-0.0250
β_2	0.0134	-0.03775	0.0134
D	0.0067**	-	-
a_0	-4.3215**	-6.1357**	-7.1854**
a_1	0.0218	0.0210	-0.0140
b_1	0.5786**	-0.2810	-0.4289**
γ_1	0.1069**	-0.0871**	0.004
c_1	0.7118**	0.4595**	0.0863**
GED parameter	1.800**	1.4861**	1.5 (fixed)
Log-Likelihood	203.56	113.4387	125.6389
Diagnostics of Standardized and Squared Residuals			
Ljung-Box (12)	12.49	223.96	23.318
	(0.254)	(0.00)	(0.010)
Ljung-Box^2(12)	6.79	143.47	11.173
	(0.75)	(0.00)	(0.344)
Jarque-Bera	1.40	1.35	956.76
	(0.50)	(0.51)	(0.00)

Note: Single and double asterisks (*) indicate statistical significance at the 0.05 and 0.01 levels respectively. P-values are in parenthesis under diagnostics of standardized and squared residuals.

The results of the EGARCH model of volatility spill-over are presented in Table 7. The X variable is the log difference of producer price of sheep in Namibia for retail and wholesale price equations. Since the mutton market in South Africa is large and dominant compared to that in Namibia, we decided to examine if price volatility from the sheep market in South Africa spills-over to into farm-level price of sheep in Namibia. In this case, the X variable is the log difference of wholesale price of sheep in South Africa[3]. It was added as an explanatory variable in the volatility model for farm prices in Namibia. The results demonstrate that there is significant volatility spill-over from the Namibian sheep market to South African sheep market. About 71 percent of the volatility in the Namibian sheep market is transmitted to the retail market for mutton in South Africa and about 58% of the transmitted volatility is carried over to the next period. The asymmetric price transmission parameter is now significant for both retail and processing (wholesale) levels for mutton in South Africa but not for farm-level price in Namibia.

An important dimension of the SSMS debate focuses on whether the volatility spill-over from the Namibian sheep market affected processors in South Africa. While 46 percent of the volatility in the Namibian sheep market is transmitted to the processing level in South Africa, the volatility does not persist. This indicates that the processors in South Africa quickly pass the price changes on to the consumers of mutton. Only about 9 percent of the volatility from the South African sheep market is spilled-over into the sheep market in Namibia and about 43 percent of the transmitted volatility is carried over to the next

[3] Since sheep and slaughtered sheep carcasses from Namibia enters the South African sheep market at the wholesale level, this is more appropriate market level than the retail level.

period. While this spill-over effect is small relative to the spill-over effect of Namibian sheep price on retail sheep market in South Africa (0.09 vs. 0.71), it, nevertheless, demonstrates that price volatility spills-over in both directions even though mutton move in only one direction across Namibia- South Africa border. The conditional variances of all estimated EGARCH models are covariance stationary (Table 7). Based on the results of J-B normality test, the standardized residuals for retail and processing level price series are normally distributed but not those from the producer price. Finally, the Ljung-Box squared standardized test statistics confirm that the EGARCH models of volatility spill-over were correctly specified.

Although the central issues we dealt with in this paper are different from those in Buguk et al (2003), the extent of volatility transmissions and their persistence are much higher in this study compared to those in Buguk et al.

7. Concluding Remarks

Namibia and South Africa are both members of the Southern African Customs Union which was originally established under the British rule on June 29, 1910. Namibia became a member of SACU formally in 1990. South Africa and BLNS initiated formal negotiations for a new SACU in November 1994. The current SACU came into effect in October 2002.

Namibia is a surplus producer of lamb and mutton in the region and South Africa has been a net importer of mutton from Namibia for a long time. Geographical proximity, the size of its economy and the SACU, all make South Africa the most preferred export market for Namibian lamb and mutton. About 80% of the sheep raised in Namibia have been exported live to and slaughtered in South Africa in recent years. Namibia introduced the "Small Stock Marketing Scheme" (SSMS) in November 2003 which came into effect on July 1st, 2004. This program removed the 15% export duty on live sheep export to South Africa and imposed quantitative restrictions on the number of live sheep export to South Africa.

The SSMS increased price volatility in the Namibian sheep market and a significant share of this volatility may have been spilled-over into the sheep market in South Africa. Although the transmission of price volatility in vertically or horizontally linked agri-food markets has received considerable attention in recent years, no study has investigated volatility spill-over effects in markets linked by virtue of a Customs Union. This article makes an attempt to bridge this gap by focusing on lamb and mutton trade between Namibia and South Africa.

The results from our EGARCH model demonstrate that about 71 percent of the volatility in the Namibian sheep market is transmitted to the retail sheep market in South Africa and the transmitted volatility remains persistent in the retail market. Our results also show that about 9 percent of the volatility from South African sheep market is spilled-over into the sheep market in Namibia and the transmitted volatility also remains persistent. Our results also demonstrate that price volatility in the sheep-market spills-over in both directions across the Namibia - South Africa border. As increased price volatility is widely believed to be welfare reducing, the empirical evidence in this article suggests that the introduction of the SSMS in Namibia has reduced welfare both in Namibia and South Africa.[4] Moreover, as sheep farmers become more dependent on export abattoirs in Namibia, their economic vulnerability would even increase further. On the other hand, the

[4] Future research should estimate the magnitude of these welfare impacts and focus on a political economy analysis of South Africa's reluctance to initiate a trade dispute against the Namibian SSMS at the WTO.

windfall gains to certified abattoirs in Namibia from the SSMS are likely to make them formidable rent-seekers who will attempt to block any move by the Namibian government to dismantle the SSMS in the near future.

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