**Mandatory Country of Origin Labeling Induced Structural Change of U.S. Meat Products**

**Osei Yeboah**
Professor & Interim Director
L.C. Cooper Jr. International Trade Center
North Carolina A & T State University
A-25 C.H. Moore Agricultural Research Facility
1601 E. Market St. Greensboro, NC 27411
Email: oyeboah@ncat.edu

**Cephas B. Naanwaab**
Assistant Professor
Department of Economics
School of Business and Economics
North Carolina A & T State University
117 Merrick Hall
1601 E. Market St. Greensboro, NC 27411
Email: cbnaanwa@ncat.edu

**Richmond Otchere**
Graduate Research Assistant
Department of Agribusiness,
Applied Economics & Agriscience Education
North Carolina A & T State University
A-18 C.H. Moore Agricultural Research Facility
1601 E. Market St. Greensboro, NC 27411
Email: rotchere@aggies.ncat.edu

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**Abstract**

Country of Origin Labeling (COOL) for meat products have been a debated subject since its implementation in March, 2009. While advocates of COOL suggest it provides valuable information to consumers, opponents on the other hand claim it imposes unnecessary cost on consumers and distort trade in affected commodities. This paper applies a Source Differentiated Almost Ideal Demand System to estimate mandatory COOL induced Structural Change in U.S. imported meat products. Included in the model is a system of equations setting consisting of beef, pork and lamb. The results show an elastic own price for beef from all countries except Canada. Pork from Canada, Denmark and Mexico; and lamb from Australia and New Zealand; has an inelastic own price. The initial impact of COOL resulted in a decline in the imports of the three meat products. Also, the Pre and Post COOL analyses show declined expenditures on all meat types from all the sources. The chow test performed indicates a structural change in all the meat types from all the sources with the exception of beef from Canada and Pork from Denmark. COOL appears to have had mixed effect on U.S. meat imports based on the source of origin of each meat type.

***Keywords*:** Country of Origin Labeling, Source Differentiated Almost Ideal Demand System, Chow Test.

**Introduction**

Country of Origin Labeling (COOL) for agricultural products, mostly imported meat products have increased interest and debate about the impact of the law since it first appeared in the Farm Security and Rural Investment Act of 2002 (2002 Farm Bill). This law required retailers to notify their customers of the country of origin of covered commodities. Covered commodities include muscle cuts of beef (including veal), lamb, chicken, goat, and pork; ground beef, ground lamb, ground chicken, ground goat, and ground pork; wild and farm-raised fish and shellfish; perishable agricultural commodities; macadamia nuts; pecans; ginseng; and peanuts (Federal Register, 2009).

The United States, with the largest fed-cattle industry in the world, is also the world's producer of beef for domestic and export consumption. Nevertheless, the United States is a net importer of beef. As the U.S. population is growing in both number and ethnic diversity, the volume and variety of food consumed and imported in the United States has increased correspondingly. Imports accounts for an increasing share of food consumed in the U.S., much of which cannot be produced domestically due to climatic conditions and seasonality of production. These imports from various countries are allowed under the provisions of the General Agreement on Tariffs and Trade (GATT) to require country of origin labeling for products coming into the country. However, the GATT provisions further require that under such labeling regimes, imported products shall not be accorded less favorable treatment than similar domestically produced goods (Article III-4).

The USDA's study on the Mandatory Country of Origin Labeling of Imported Fresh Muscle Cuts of Beef and Lamb reveals that some livestock producer organizations and farmer organizations supported mandatory labels, while importers, meatpackers, food processors, and grocers were opposed (FSIS, 2000). For U.S. farmers to benefit financially from mandatory labels, consumers would have to prefer domestic products to imports. If consumers do prefer domestic products, labels would allow consumers to discriminate between imports and domestic products. As a result, demand for domestic meat products in the United States would rise along with domestic meat prices. Further, domestic products would increase their market share at the expense of imports. However, if consumers do not generally prefer domestic products, labeling will not confer any financial benefits to domestic producers. These incremental costs incurred by producers, wholesalers, distributors, retail chain stores, consumers and others within the supply chain has necessitated the essence to estimate the demand shifts for beef associated with the implementation of COOL that will minimize losses in social welfare of producers, who are largely affected by this policy.

Consumers critics of COOL have argued again that “COOL is a failed program that will soon cost not only the beef industry, but the entire U.S. economy, with no corresponding benefit to consumers or producers” (Needham, 2014). It has become imperative to investigate the value of Mandatory Country of Origin Labeling (MCOOL) to consumers and the cost it imposes on meat producers. Canadian officials also have claimed COOL complicates the importing/exporting process for Canada, driving up the price of their exports. Again, trading partners, led by Canada and Mexico, have challenged MCOOL and presented their case to the World Trade Organization (WTO). The WTO has ruled mainly in favor of this challenge and the United States is in the process of responding to this ruling (WTO, 2012). So USDA made the labels more specific in an attempt to win WTO approval. Now the labels say, for example, that the animal that produced the meat was "born in Mexico, raised and slaughtered in the United States" or "born, raised and slaughtered in the United States." The WTO rejected those revised rules in 2014, and the United States filed one last appeal, which was also rejected by the WTO. However, the Appellate Body also upheld the ruling that U.S. COOL statue violates TBT agreement, in that “accords less favorable treated to imported Canadian cattle hogs than to like domestic cattle hogs” (WTO Appellate Body, 2012).

Canada and Mexico won a final WTO ruling in May, 2014, and are now seeking retaliatory actions valued at a combined $3.7 billion a year. Canada has threatened trade restrictions on a range of U.S. products, including meat, wine, chocolate, jewelry and furniture. This necessitated the U.S. House voting in June 2015, to remove country-of-origin labels on beef, pork and chicken sold in the U.S., hoping to prevent a protracted battle over the labels with Canada and Mexico. Consumer advocates, among the biggest supporters of the labels, say international trade deals should not trump consumers’ access to information about their food. Top Democrat, Sen. Debbie Stabenow of Michigan, said that she will oppose efforts to get rid of them altogether. In a statement she added that, “I plan on working with my Senate colleagues to develop legislation that ensures consumers have information about where their food comes from while also meeting our international trade obligations,” Ms. Stabenow said. This shows that the battle of COOL have not yet ended though the law have been repealed. It has become imperative to investigate the value of Mandatory Country of Origin Labeling (MCOOL) to consumers and the cost it imposes on meat producers and consumers’ response to mandatory COOL induced increased prices.

**Literature Review**

A number of studies have determined that the implementation of COOL could have additional cost burden on producers and consumers. According to the United States

Department of Agriculture, Agricultural and Marketing Services in 2003 estimated that the record keeping cost of COOL cost on all industries would be around $1.9 billion.

Taylor, Glynn and Tonsor (2013) reveal that after the implementation of MCOOL, there were no changes in consumer demand for meat products. They also indicated a net economic welfare loss for meat producers.  Contrary, a study by Chang, Zhang and Peel (2009) on the effects of country of origin labeling in the U.S meat industry with perfectly competitive processors show that producer surplus increases as the elasticity of domestic demand becomes more elastic with respect to the price of imported products.

Umberger (2004) discovers consumers' willingness-to-pay (WTP) for labeled meat products in the U.S. The study was conducted through a survey of 243 consumers in Colorado. The results reveal that consumers were willing to pay up to 58% and 38% on "Certified US" hamburger and steak respectively. There is indication from studies that although consumers show a willingness-to-pay a premium for the source assurance provided by country-of-origin labels, the premiums would only exist if U.S beef was perceived to be safer and of higher quality than imported beef (Umberger, 2004).

A study by Lusk and Anderson (2004) to determine the effects of country of origin labeling on meat producers and consumers. In their study, they used the equilibrium displacement model of the farm, wholesale and retail markets for beef, pork and poultry to demonstrate how the welfare of producers and consumers will be affected by COOL. Their findings showed that as the costs of COOL are shifted from the producer to the processor and retailer, the producer is made increasingly better off while consumers are made increasingly worse off.). But they found that an increase in aggregate consumer demand of 2% to 3% is likely to be sufficient to offset lost producer welfare due to COOL cost Lusk and Anderson (2004).

Hanselka, Davis, Anderson and Capps (2004), modeled the demand shifts in beef associated with country of origin labeling to minimize losses in social welfare. This study explored a cost assessment based on survey results for COOL implementation and demand change estimates for beef required to offset implementation costs were provided. The survey results indicated a $1.9 billion additional annual cost estimates (based on 2003 production levels) for the beef industry in order to comply with COOL requirements; a figure closely matching that estimated in other literature. A model that employs elasticity estimates together with livestock and beef numbers were developed for estimating the necessary shifts in demand. Results obtained from the model show a needed percentage increase of 1.2 in beef demand in order to balance the welfare losses and gains in the retail sector. A 0.8% increase in wholesale demand for carcasses is required for the producers and consumers in the wholesale sector to be no worse off.

Most existing literature on COOL have been conducted spanning from consumers' perception and willingness to pay for products labeled with country of origin. Also included in most studies of COOL are the welfare impacts of implementing COOL and the mechanisms through which country of origin labeling serve as food safety and quality. Most of these studies were conducted before the implementation of COOL. However, this study uses data of both pre and post implementation of mandatory COOL. This current study assesses the mandatory country of origin labeling induced structural change of U.S. meat products. To achieve this we employ the source-differentiated Almost Ideal Import Demand (SD-AIDS) model to derive price and expenditure elasticities. We compare expenditure elasticities from the pre and post implementation and determine any changes in expenditure elasticities showing how consumers' respond to mandatory COOL.

Most empirical work on structural change due to policy amendments, price changes and preferences influencing consumer demand made use of the Armington model, the Rotterdam model and the Almost Ideal Demand model among others. Such studies include a work by Yang and Koo (1994), on the Japanese Meat Import Demand Estimation with the Source Differentiated AIDS Model. A source differentiated AIDS demand model was specified to estimate Japanese meat import demand (Yang and Koo, 1994). It was shown that using the AIDS model without source differentiation would result in spurious conclusions, and as such demand systems confined to an individual meat bias elasticity estimates.

In another study, Thevenaz (2011), identified structural changes in the US production style and operations of the hog industries which has created an integrated U.S./Canadian system over the past decade. Employing a system of simultaneous equations, representing US import demand and US price, this study estimated the reduction in trade and any possible effects in both live hogs and feeder pigs associated with the implementation of MCOOL. The results showed that MCOOL reduced trade in live hogs between US and Canada by 37.8 percent, and that in feeder pigs reduced by 24.1 percent. The study concluded that MCOOL had no effect on the price of both live hogs and feeder pigs in the US market.

Coulibaly (2013), analyzed parameter stability before and after the year 2001 through a Chow test to capture the impact of the change in import tariff subsequent to the rice sector liberalization that was effective from 1997. The two sub-samples were tested against the overall sample from 1996 to 2011 using an adjusted likelihood ratio test as proposed by Italianer (1985) in the singular SUR system. The results of the parameter stability test of the null hypothesis of no structural change after 2001 is rejected at a 1% level of confidence. Therefore, the results imply that change in the tariff policy (reduction in tariff) after 2001 created incentives for importers to increase their supply of rice from the international market.

Contrary, a study by Wozniak (2010) to determine if Country of Origin Labeling had influenced Salmon Consumption using a Non Linear AIDS model to estimate three salmon products - precooked, uncooked fresh, and uncooked frozen. A comprehensive evaluation of structural stability for the system-wide model was done using a series of Chow tests to check for structural change in some or all of the parameters in a model 24 weeks prior to, and 24 weeks after, COOL suggests stable consumer demands.

**Methodology**

Several studies on import demand has come up with several demand functions for estimation. The most widely used of the demand function models is the AIDS model and extensively used by several authors (Eales and Unnevehr, 1998; Green and Alston, 1990; Fulponi, 1989; Hayes et al., 1990) because it provides flexible functional forms and relatively easy to estimate.

We model U.S. meat import demand such that meat product is differentiated by source (country) of origin labeling. Following this, we employ Yang and Koo (1994) source differentiated (SD-AIDS) to analyze the import demand for meat products. Other models such as the Armington model and the Rotterdam model have also been used for source differentiation import demand analysis. However, the advantage of the source-differentiated AIDS model over the Armington model is that the SD-AIDS model does not impose block separability in source differentiation. The Armington model imposes restrictive assumptions of a single constant elasticity of substitution (CES) and homotheticity which may generate biased parameter estimates Yang and Koo, (1994).

The source differentiated of the Almost Ideal Demand model is presented as follows;

$$W_{ih} = \alpha_{ih} + \sum_j \sum_k \gamma_{ihjk} \ln (P_{jk}) + \beta_{ih} \ln(Y/P) + \alpha_{ihm} D_m \quad (1)$$

Where the dependent variable, $W_{ih,}$ is the share of meat type i imported from source h. Where subscripts i and j denote type of meat product imported; h and k represents sources of meat import; lnY is the expenditure term; lnP is the stone's geometric price index, and $D_m$ is an indicator variable to capture the implementation of mandatory cool. This model assumes that meat products are separable from other food and non-food consumption items (LaFrance, 1991; Edgerton, 1997). The expenditure and price terms are defined as follows;

$$\ln(Y) = \sum_i \sum_h \ln (p_{ih}) * \ln (q_{ih}) \quad (2)$$

$$\ln(P) = \sum_i \sum_h w_{ih} \ln(p_{ih}) \quad (3)$$

The following restrictions are imposed to satisfy the general demand theory;

**Adding up:** $\sum_i \sum_h \alpha_{i\,h} = 1; \sum_i \sum_h \Upsilon_{ih\,jk} = 0; \sum_i \sum_h \beta_{ih} = 0$ **(4)**

**Homogeneity:** $\sum_j \sum_k \Upsilon_{ih\,jk} = 0$ **(5)**

**Symmetry:** $\Upsilon_{ih\,jk} = \Upsilon_{ih\,jk}$ **(6)**

Source- differentiated Marshallian elasticities are defined as follows;

**Expenditure elasticity:** $\eta_{ih} = \beta_{ih}/w_{ih} + 1;$ **(7)**

**Marshallian price elasticity:** $\varepsilon_{ih\,jk} = \delta_{ih\,jk} + \gamma_{ih\,jk}/w_{ih} - \beta_{ih}(w_{jk}/w_{ih})$ **(8)**

Where $\delta_{ih\,jk}$ is the kronecker delta, equal to unity if i= j and h= k, and zero otherwise.

The SD-AIDS model was estimated by a system of equations consisting of beef, pork and lamb differentiated by source country. This is subject to the restrictions of adding up, homogeneity and symmetry in using iterative seemingly Unrelated Regression method of Zellner. The lamb equation from the analysis was dropped to avoid singularity of the variance and covariance matrix. The adding up conditions was used to recover the lamb equation.

**U.S. Import Demand: Testing for Structural Change**

We assumed that no structural change has occurred in the demand for imported meat products following the estimation of the AIDS model demand equation as presented in equation (1). A structural change in import demand may show there have been changes in tastes and preferences for various meat products. To show the possibility of any structural changes in the import of meat products from different sources, we conducted the Chow test in stata.

This was done by constructing a dummy variable Dts = 0 before the implementation of mandatory COOL, otherwise, 1 in a regression of the full model and then using the test command on those dummies.

We started the chow test by considering the model;

**y = a + b*x1 + c*x2 + . . . n*x14 + u**

The formula for the "Chow test" of this constraint is

$$\frac{\dfrac{ess\_c - (ess\_1+ess\_2+\ldots+ess\_14)}{K}}{\dfrac{ess\_1 + ess\_2+\ldots+ess\_14}{\quad}}$$

**N_1 + N_2+…+N_14 - 14*k**

This is the formula commonly referred to as **ess_1, ess_2 + . . . +ess**_14. These are the error sum of squares from the separate regressions, **ess_c** is the error sum of squares from the pooled (constrained) regression, **k** is the number or estimated parameters (**k**=15 in our case), and **N_1** to **N_14** are the number of observations in the groups. The resulting test statistic is distributed **F (k, N_1+N_2 + . . . + N_14+N-14*k)**, where any possibility of structural change is captured through the chow test. In this case when the Ho: parameter stability is structural stable when the probability is less than 5%, then we do reject Ho: (i.e. the null hypothesis that Ho: no structural change). This therefore means that there is structural break in the data. In Stata 12 or more recent versions, you can also use the contrast command with factor variables to perform the same test:

**Data and Estimation Procedures**

The study uses monthly U.S import demand of meat products from the major sources of U.S meat imports. The data were collected from the USDA Foreign Agricultural Service database (GATS database). The monthly U.S import demand of meat products data runs through January 1989 to December 2014. This captures the combined data from 1989 to 2014. The pre COOL data runs from 1989 to 2008 while the post COOL data t is from 2009 to 2014. The data consists of prices and quantities of three main U.S imported meat products, namely, beef (including veal, fresh and chilled), pork (fresh and chilled), and lamb (including mutton and goat). Poultry is left out because the U.S does not import significant quantities of poultry meat or products.

Countries covered under the study include Australia, Canada, Mexico, Uruguay, Denmark, New Zealand, Poland and the rest of the countries were added together as other sources. A country was identified as an import origin for the beef market if it was part of the first five largest exporting countries and first four largest exporting countries for Pork and the first two exporting countries for Lamb. The other countries were combined into “other sources”.

An Iterated Seemingly Unrelated regression process of SAS version was used to estimate the Source Differentiated Almost Ideal Demand Systems (SD-AIDS) model in levels to derive the price and expenditure elasticity estimates. The theoretical restrictions of homogeneity and symmetry were imposed in the estimation of the price and expenditure elasticity estimates. Three data sets were estimated; the combined data from 1989 to 2014; the Pre COOL data from 1989 to 2008 and the Post COOL data from 2009 to 2014.

The sample statistics of expenditure shares for each meat product from a source origin are summarized in table 1. For the period of the sample data, the U.S. spent over 60% of its meat consumption on beef imports. This is twice the imports of Pork into the U.S. and more than five times the import of Lamb into the country. Major sources of beef include Australia which accounted for about 18% of the total beef import, which was closely followed by Canada of about 17% and New Zealand, around 12%. Pork imports into the U.S. is mainly from Canada which accounts for about 16% out of the total pork imports which is widely separated from the second leading by Denmark of 4%. Lamb imports accounts for a total of about 6% which is a small fraction out of the total U.S. meat imports.

Preliminary exploratory data analysis was done to determine trends in meat imports from different sources. This is illustrated in figure 1, 2 and 3 respectively for beef, pork and lamb imports respectively.

**Results and Discussions**

Table 3 reports the parameter estimates for the combined data from 1989 to 2014 of the SD-AIDS model. The entire estimated parameter coefficients were significant at 5% with the exception of beef from Australia and New Zealand; and Pork from Mexico. The estimated parameter coefficients with the expected signs are beef from Australia, New Zealand and Uruguay; and Pork from Poland. Table 5 and 7 represents the parameter estimates of the Pre COOL and Post COOL data sets. The estimated parameter estimates of the Pre COOL are all significant at 5% level with only beef from Australia and Uruguay: and Pork from Poland having the expected signs. However, 8 out of the 14 estimates of the Post COOL were significant at the 5% level with beef from Canada, New Zealand, and Uruguay; and Pork from Poland having the expected signs.

Tables 4, 6 and 8 report the uncompensated demand elasticities for the combined data elasticity estimates, Pre COOL elasticity estimates and the Post COOL elasticity estimates respectively. The own price elasticities for the combined data are all negative as expected with an exception of beef from Canada and Pork from other sources. For beef, the own price were elastic with the exception of Canada, Brazil and Other Sources. This reflects how responsive COOL induced increased prices of imported beef from Australia: -1.17, New Zealand: -1.14 and Uruguay: -3.3. It may be heavily affected by the implementation of mandatory COOL. However, Pork and Lamb from the various importing countries have been generally inelastic (with an exception for Pork from Poland). This reflects the insensitivity of the mandatory COOL on the Pork from various importing countries into the United States.

The Pre COOL own price elasticity for all the meat products from the various importing countries are all negative (with an exception for beef from Canada and Pork from other sources) and statistically significant at the 5% level. This result is not different from the combined data elasticity estimates. But the Pre COOL own price for beef are inelastic with an exception for Beef from Australia and Uruguay. This shows how the U.S. beef import was insensitive to price changes before the implementation of mandatory

COOL. The own price elasticities for pork and lamb on the other hand, are not different from the combined data elasticity estimates. They are negative (with an exception of pork from Poland) and inelastic. Again, this shows the insensitivity of U.S pork and lamb import to price changes before the implementation of mandatory COOL.

The Post COOL own price elasticity of the meat types from the various importing countries were all negative (with an exception for pork from other sources) as suggested by theory. Beef prices that are elastic are Canada -1.42; New Zealand -1.31 and Uruguay -1.8 and these are statistically significant at the 1% level.

The Marshallian Cross price elasticities depict the competitiveness among the different meat types from the various importing countries. This shows either substitutability or complementarity relationships among meat types from the various importing countries. While a significant positive cross price elasticity estimate between meat types from different countries may depict substitutability, a significant negative cross price elasticity may indicate complementary relationship. Justifying a complementary relationship between meat types is difficult since most meat types are all sources of animal protein and therefore are expected to substitute for one another in human consumption (Muntondo and Henneberry, 2006).

Regarding cross price elasticity for the combined data of the beef market, the results show that beef from New Zealand is a net substitute for beef from various importing sources to the US, meaning an increase in the price of beef from New Zealand results in an increase in the quantity demanded from the various importing countries. However, meat products from other countries such as Australia, Canada, Brazil and Uruguay showed a mixture of substitutability and complementarity. Australian beef showed a complementary relationship between Canadian, Brazilian and other sources beef and were all statistically significant at the 5% level. This means that at the 5% significance level, an increase in the price of beef from Australia, will lead to a decrease in the quantity demanded from Canada, Brazil and other sources, holding other factors constant. Canada on the other hand showed a high level of substitutability relationship between New Zealand, Brazil and other sources. Thus an increase in the price of beef from Canada will lead to an increase in the quantity demanded from New Zealand, Brazil and other sources.

The cross price elasticity for the Pork and lamb also showed a mixture of substitutability and complementarity among the importing countries. But pork from Canada showed that an increase in the price of Pork from Canada will lead to an increase in the quantity demanded from Denmark, Poland and other sources. Lamb from Australia showed that an increase in the price of lamb accompanies an increase in the quantity demanded from New Zealand and other sources.

Again the Pre COOL cross price elasticity also did show that beef from New Zealand is a net substitute to beef from the various importing sources to the U.S. which is not different from the combined data. Australia showed a high relationship of substitution between Canada, New Zealand, Brazil and Uruguay. That is, an increase in the price of beef from Australia will lead to an increase in the quantity demanded from Canada, New Zealand, Brazil and Uruguay. Canada also was not any different from Australia which also showed a high relationship of substitutability with Australia, New Zealand, Brazil and Uruguay. Again this what not any different with New Zealand. Brazil showed a mixture of substitutability and complementary among the other countries. Pork and Lamb on also did show a mixture of substitutability and complementarity among the various importing countries. Canada, Denmark and Mexico showed a high substitution level among the other countries while Poland showed a complementary relationship. For the lamb market New Zealand showed substitutability relations with the other importing countries, meaning that an increase in the price of lamb from New Zealand will lead to an increase in the quantity demanded from Australia and Other sources.

Results from the Post COOL analysis on cross price elasticity of the beef market, the results reveals that an increase in the price of beef from Uruguay leads to a decrease in the quantity demanded from Australian Canada, Brazil and Uruguay. Australia, Brazil and Canada also showed a high level of substitutability to beef from the other importing countries than complementary. For the pork market Canada showed a high level of complementary, meaning that an increase in the price of pork from Canada accompanies a decrease in the quantity demanded from Denmark and Poland with the exception of Mexico. However, the other importing countries showed a mixture of substitutability and complementary among themselves. Regarding the cross price elasticity of the lamb market, the importing countries under consideration showed a mixture of substitutability and complementary.

The expenditure elasticities for the Combined COOL data, Pre COOL and Post COOL are presented in the last but one row of tables 2, 4 and 6. The expenditure elasticities estimates of the COOL combined data for the beef market shows negative signs for Australia; -0.00026, Canada; -0.00035, Brazil; -0.00022 and other sources; -0.00082. This is not different for the pork market as the following countries also showed negative signs; Canada; -0.00104; Denmark; -0.00015; Poland; -0.0001 and other sources; 0.00013. The Lamb market was not any different as Australia showed a negative sign of 0.001 as well as other sources of -2.32. These expenditure estimates reveal how U.S. meat import are easily affected by any policy (COOL) that causes cost of production to increase thereby increasing the prices of the meat products.

Regarding the Pre COOL, the expenditure elasticities for the beef market also showed negative expenditure elasticity for beef imported from Australia; -0.00061, Canada; -0.0004, Brazil; -0.0001 and other sources -0.00109, the pork market was no different as Canada, Denmark, Poland and Other Sources all showed negative signs. However, imported lamb from Australia, New Zealand and Other Sources all showed positive signs of 0.000286; 0.00023; and 7.24 respectively.

The Post COOL beef market had positive signs for Canada; 0.000686 and New Zealand; 0.001499. Australia, Brazil, Uruguay and other sources were all negative and less than 1. Imported Pork from the countries under consideration all had negative signs with the exception of Denmark; 0.000034. Lamb on the hand also had all negative signs with the exception for New Zealand. This reveals that, imported meat products from most importing countries have reduced the amount of goods they export due in part to increased cost of production because of the mandatory COOL policy.

**Structural Change**

To capture the impact of the COOL policy, parameter stability is analyzed through a chow test. The test results for the structural change of the beef market shows a negative sign in the share coefficients beef import from Canada, New Zealand, Brazil and Uruguay which were all statistically significant at the 1% level with the exception of Canada. These show a structural change in the import of beef from all countries with the exception of Canada which shows no structural change in the import of beef. This reveals that mandatory COOL may have in part and or in totality, affected the import of beef from these countries. In other words, mandatory COOL have caused a decrease in the import of beef from Canada, New Zealand, Brazil and Uruguay. Beef from Australia and other sources show a positive sign indicating an increase in beef imports from these sources.

Pork from Canada, Denmark, Mexico and other sources all showed a positive structural change with the exception of Poland which showed a negative structural change. This shows that the U.S. has seen an increase in the import demand of Pork from Canada, Denmark and Mexico despite the implementation of mandatory COOL which opponents argues that it imposes unnecessary cost to producers.

Lamb from Australia, New Zealand and other sources show a positive structural change. In other words, despite the implementation of mandatory COOL policy in 2009, lamb imports into the U.S. was not affected and showed an increase in lamb imports from Australia, New Zealand and other sources.

**Summary and Conclusions**

This paper analyzes the structural change due to mandatory COOL on U.S. imports of beef (including veal, fresh and chilled), Pork (including fresh and chilled), and Lamb (including mutton and goat) using the Source Differentiated Almost Ideal Demand Systems. The chow test was used to test for structural change in imported meat products from different countries. The results on estimated price and expenditure elasticity revealed that the share of beef from the importing countries were more elastic as compared to the share of pork and lamb. In other words, the share of beef imported from Australia, New Zealand, Brazil and Uruguay have declined while the share of beef from Canada have increased. The share of Pork from Canada, Denmark and Mexico also decreased with the exception of Poland which increased. This was not different with the share of Lamb from Australia and New Zealand as they also decreased. This depicts how the beef industry is more affected by the implementation of mandatory COOL than the pork and lamb market.

As shown in the elasticity tables, the expenditure elasticities on meat products especially the beef sector has decreased in correspondence to a decrease in import demand of beef into the U.S. Most expenditure elasticity were all less than 1 showing that expenditure on meat products have shifted. Part or in totality of this may be due to an increase in the prices of meat products due to mandatory COOL and consumers are finding other alternatives for beef, pork and lamb.

The Pre and Post COOL analysis of the price elasticities shows a mixed effect of elasticity and inelasticity on U.S. import demand based on the origin of each meat product. The expenditure elasticities of both the Pre and Post COOL analysis did not see any increase following the implementation of mandatory COOL.

The chow test results for the structural change shows a negative structural change for all beef imported from different sources with the exception of Canada. Canada, not showing any structural change in its beef imports into the U.S. due to mandatory COOL induced prices may be due to proximity to the U.S. and consumers' taste and preferences for Canadian beef. Regarding the pork and the lamb market, all the importing countries show a positive structural change implying an increase in the demand imports of these meat category with the exception of pork from Poland which showed a negative structural change and pork from Denmark which showed no structural change. This reveals that mandatory COOL appears to have had different effects on U.S. import demand based on the source of origin of each meat category.

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**Appendix**

**List of Figures:**

**Figure 1. U.S. Beef Imports, 1989-2014**

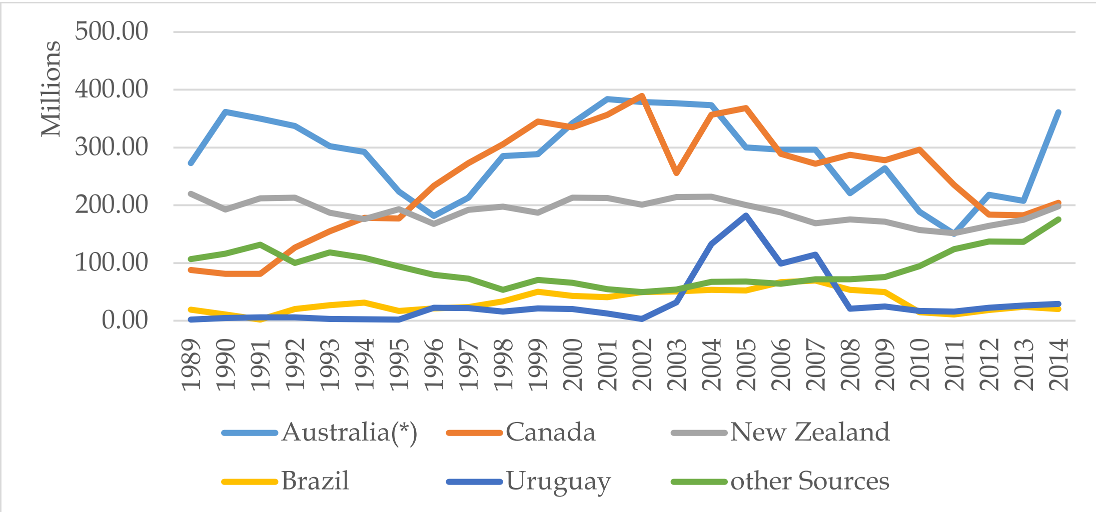



**Figure 2. U.S. Pork Imports, 1989-2014**

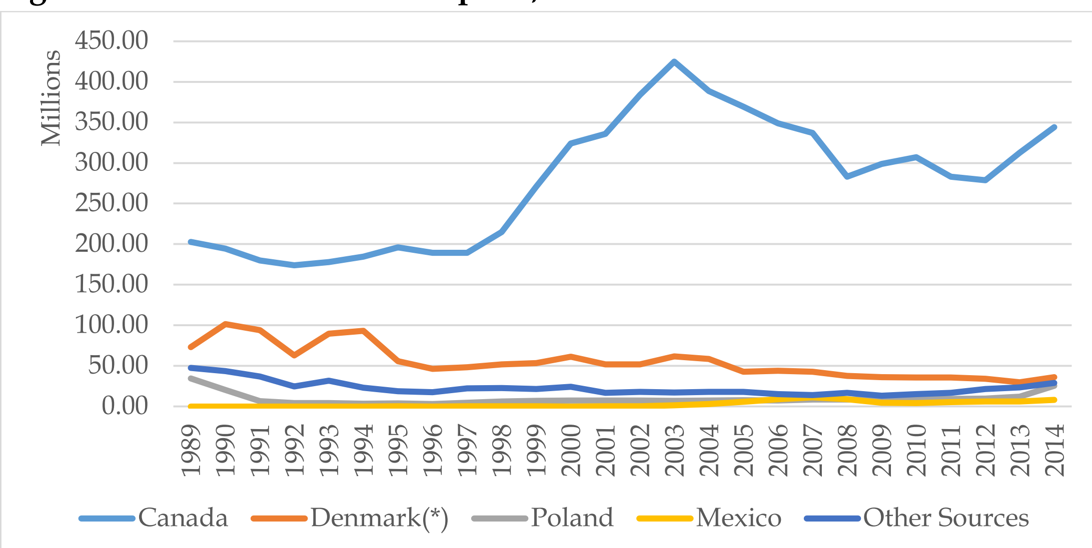
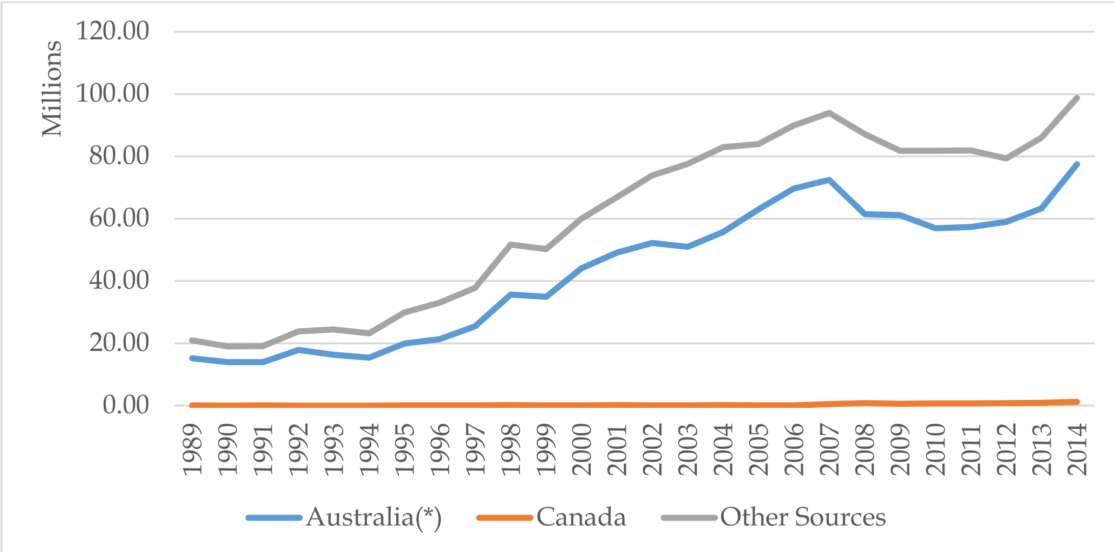


**Figure 3.** **U.S. Lamb Imports, 1989-2014**



**List of Tables:**

**Table 1. Summary Statistics for Expenditure Share of U.S. Meat Imports for 1989-2014**

| | Mean | Std. Deviation | Minimum | Maximum |
|---|---|---|---|---|
| **Beef** | | | | |
| Australia | .179423 | .0624923 | .0047 | .4194 |
| Canada | .165747 | .0680799 | .0000 | .3227 |
| New Zealand | .122646 | .0513815 | .0036 | .2821 |
| Brazil | .029532 | .0168021 | .0000 | .0795 |
| Uruguay | .019293 | .0202744 | .0006 | .1001 |
| Other Sources | .120481 | .0938335 | .0068 | .7185 |
| **Pork** | | | | |
| Canada | .155615 | .0338786 | .0459 | .2767 |
| Denmark | .048843 | .0226995 | .0124 | .1222 |
| Poland | .009462 | .0076746 | .0015 | .0508 |
| Mexico | .001698 | .0021157 | .0000 | .0080 |
| Other Sources | .020590 | .0104707 | .0047 | .0787 |
| **Lamb** | | | | |
| Australia | .040964 | .0260502 | .0020 | .1239 |
| New Zealand | .022045 | .0118919 | .0019 | .0663 |
| Other Sources | .000428 | .0009522 | .0000 | .0104 |

**Table 2. Chow Test for the Structural Change of the Expenditure Share of Meat Products**

| | Share Ceoef | Std | Expenditure | Cool | R-Squared |
|---|---|---|---|---|---|
| **Beef** | | | | | |
| Australia | 0.00451*** | 0.057568 | -0.00081 | -0.03888 | 0.5764 |
| Canada | -0.00582 | 0.02004 | 0.000258 | 0.232509 | 0.7929 |
| New Zealand | -0.07565*** | 0.044484 | 0.001854 | -0.10104 | 0.6039 |
| Brazil | -0.00179*** | 0.003232 | 0.000064 | -0.02459 | 0.7319 |
| Uruguay | -0.02841*** | 0.004061 | 0.000217 | 0.078824 | 0.7097 |
| Other Sources | 0.08469** | 0.005652 | -0.00103 | -0.54254 | 0.7768 |
| **Pork** | | | | | |
| Canada | 0.04821*** | 0.014646 | -0.0005 | 0.172306 | 0.702 |
| Denmark | 0.00266 | 0.009523 | -1.7E-05 | -0.03296 | 0.7881 |
| Poland | -0.03293** | 0.003199 | -8.4E-05 | -0.01593 | 0.6279 |
| Mexico | 6.26E-07*** | 0.000117 | 1.75E-05 | 0.010836 | 0.8076 |
| Other Sources | 0.029214** | 0.002279 | -8.8E-05 | -0.07687 | 0.7005 |
| **Lamb** | | | | | |
| Australia | 0.022278*** | 0.004112 | 3.44E-05 | 0.258518 | 0.8686 |
| New Zealand | 0.012749*** | 0.002741 | 0.000107 | 0.171892 | 0.8179 |
| Other Sources | 0.00023*** | 4.36E-05 | 1.92E-06 | -6.4E-05 | 0.6678 |

Note: t-values in paranthesis, ***,**,*, implies significant at 1%, 5% & 10% respectively

**Table 3. Parameter Estimates for Imported Meat products from Major Countries using SD-AIDS model in levels (All data)**

| | Beef | | | | | | Pork | | | | | Lamb | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Elasticity of** | **Australia** | **Canada** | **New Zealand** | **Brazil** | **Uruguay** | **Other Sources** | **Canada** | **Denmark** | **Poland** | **Mexico** | **Other Sources** | **Australia** | **New Zealand** | **Other Sources** |
| **pbf_aus** | -0.0 3015 | -0.05452*** | 0.109775*** | -0.01199** | 0.06324*** | -0.01536*** | -0.00361 | -0.01991*** | -0.0016 | 0.002685*** | 0.000879 | -0.04103** | -0.02945*** | 0.00134** |
| **pbf_can** | -0.05452*** | 0.192975*** | 0.032656** | 0.014763*** | -0.0163*** | 0.012121*** | 0.108373*** | 0.022429*** | 0.013645*** | -0.00289*** | 0.011869*** | 0.028852*** | 0.012985 | -0.00042*** |
| **pbf_nez** | 0.109775*** | 0.032656** | -0.01704 | 0.018246*** | 0.017682*** | 0.030149*** | 0.006967 | 0.018386** | 0.015061*** | -0.00158* | -0.00293 | 0.008859 | 0.004098 | -0.00098 |
| **pbf_bra** | -0.01199** | 0.014763*** | 0.018246*** | 0.015293*** | -0.00224 | 0.005528*** | -0.00153 | -0.00101 | 0.000542 | -0.00017 | 0.000129 | 0.006384*** | 0.00317*** | -0.00104*** |
| **pbf_uru** | 0.06324*** | -0.0163*** | 0.017682*** | -0.00224 | -0.04443*** | 0.006022*** | 0.000327*** | 0.016362*** | 0.003393*** | -0.00035 | 0.006581*** | 0.004082** | 0.003197** | 0.000208 |
| **pbf_os** | -0.01536*** | 0.012121*** | 0.030149*** | 0.005528*** | 0.006022*** | 0.118854*** | 0.009448*** | 0.008029*** | 0.005047*** | -0.00106*** | 0.003266*** | -0.01274*** | -0.00623*** | -0.00003 |
| **ppo_can** | -0.00361 | 0.108373*** | 0.006967 | -0.00153 | 0.000327*** | 0.009448*** | 0.105708*** | 0.035284*** | 0.016713*** | -0.00182*** | 0.010328*** | 0.016727*** | 0.003923 | 0.000279 |
| **ppo_den** | -0.01991*** | 0.022429*** | 0.018386** | -0.00101 | 0.016362*** | 0.008029*** | 0.035284*** | 0.018539*** | 0.017838*** | -0.00003 | 0.002944 | -0.01969*** | -0.00534*** | 0.000394 |
| **ppo_pol** | -0.0016 | 0.013645*** | 0.015061*** | 0.000542 | 0.003393*** | 0.005047*** | 0.016713*** | 0.017838*** | -0.01813*** | 0.000161 | -0.0032*** | -0.00669*** | -0.00397*** | -0.00003 |
| **ppo_mex** | 0.002685*** | -0.00289*** | -0.00158* | -0.00017 | -0.00035 | -0.00106*** | -0.00182*** | -0.00003 | 0.000161 | 0.000089 | -0.00007 | -0.0007 | -0.00033 | -0.00005 |
| **ppo_os** | 0.000879 | 0.011869*** | -0.00293 | 0.000129 | 0.006581*** | 0.003266*** | 0.010328*** | 0.002944 | -0.0032*** | -0.00007 | 0.021122*** | 0.018277*** | 0.009049*** | -0.0001 |
| **plm_aus** | -0.04103** | 0.028852*** | 0.008859 | 0.006384*** | 0.004082** | -0.01274*** | 0.016727*** | -0.01969*** | -0.00669*** | -0.0007 | 0.018277*** | 0.016055*** | 0.01006*** | 0.000545** |
| **plm_nez** | -0.02945*** | 0.012985 | 0.004098 | 0.00317*** | 0.003197** | -0.00623*** | 0.003923 | -0.00534*** | -0.00397*** | -0.00033 | 0.009049*** | 0.01006*** | 0.006087** | -0.00006 |
| **plm_os** | 0.00134*** | -0.00042*** | -0.00098 | -0.00104*** | 0.000208 | -0.00003 | 0.000279 | 0.000394 | -0.00003 | -0.00005 | -0.0001 | 0.000545** | -0.00006 | 0.000372*** |
| Income Coeff. | 0.998553*** | 0.997865*** | 1.013839*** | 0.992476*** | 1.002218*** | 0.99319*** | 0.993295*** | 0.996872*** | 0.988925*** | 1.004693*** | 0.993906*** | 0.997678*** | 1.006703*** | 0.994579*** |

Note: t-values in paranthesis, ***,**,*, implies significant at 1%, 5% & 10% respectively

| Table 4. | Elasticity Estimates for Imported Meat products from Major Countries using SD-AIDS model in levels (All Data) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Beef | | | | | | Pork | | | | | Lamb | | |
| Elasticity of | Australia | Canada | New Zealand | Brazil | Uruguay | Other Sources | Canada | Denmark | Poland | Mexico | Other Sources | Australia | New Zealand | Other Sources |
| pbf_aus | -1.16778*** | -0.3036*** | 0.611999*** | -0.06678** | 0.35249*** | -0.08545*** | 0.01992 | -0.11088*** | -0.00896 | 0.014964*** | 0.00493 | -0.22863*** | -0.16408*** | 0.007468** |
| pbf_can | -0.32852*** | 0.164625** | 0.197283** | 0.08913*** | -0.09831*** | 0.073387*** | 0.654177*** | 0.135425*** | 0.082343*** | -0.01741*** | 0.071651*** | 0.17416*** | 0.078387*** | -0.00254 |
| pbf_nez | 0.892571*** | 0.263967** | -1.14062*** | 0.148365*** | 0.143903*** | 0.244158*** | 0.054653 | 0.149237** | 0.122666*** | -0.01291* | -0.02416 | 0.071664 | 0.03311 | -0.00796 |
| pbf_bra | -0.40461** | 0.501123*** | 0.61877*** | -0.48194*** | -0.07583 | 0.188085*** | -0.05071 | -0.03388 | 0.018419 | -0.00581 | 0.004523 | 0.216475*** | 0.107515*** | -0.03532*** |
| pbf_uru | 3.277492*** | -0.84531*** | 0.916227*** | -0.11637 | -3.30292*** | 0.311855*** | 0.016598 | 0.847997*** | 0.175851*** | -0.01803 | 0.341058*** | 0.211485** | 0.165657** | 0.010785 |
| pbf_os | -0.12629*** | 0.101735*** | 0.251078*** | 0.046083 | 0.050112*** | -0.01268*** | 0.079478 | 0.06697*** | 0.041959*** | -0.00881*** | 0.027246*** | -0.10549*** | -0.0516*** | -0.00021 |
| ppo_can | -0.02202 | 0.697528*** | 0.045594 | -0.00965 | 0.00223 | 0.061521** | -0.31966*** | 0.227066*** | 0.107466*** | -0.01168*** | 0.066505*** | 0.107767*** | 0.025356 | 0.001799 |
| ppo_den | -0.40701*** | 0.459727*** | 0.376819** | -0.02061 | 0.33506*** | 0.164752*** | 0.722884*** | -0.62029*** | 0.36524*** | -0.00058 | 0.060346 | -0.40299*** | -0.10917** | 0.008068 |
| ppo_pol | -0.16822 | 1.443882** | 1.593025*** | 0.057591 | 0.358808*** | 0.534774*** | 1.768081*** | 1.885737*** | -2.91605*** | 0.016994 | -0.33809*** | -0.70674*** | -0.41954*** | -0.00273 |
| ppo_mex | 1.580514*** | -1.70105*** | -0.93185* | -0.1015 | -0.20494 | -0.62693* | -1.07249*** | -0.01697 | 0.094573 | -0.94751*** | -0.04155 | -0.41203 | -0.19333 | -0.02925 |
| ppo_os | 0.043798 | 0.577435*** | -0.14144 | 0.006445 | 0.31973*** | 0.159342*** | 0.502531*** | 0.143295 | -0.15542*** | -0.00341 | 0.025938 | 0.887932*** | 0.439639*** | -0.00509 |
| plm_aus | -1.00123*** | 0.704718*** | 0.216544 | 0.155912*** | 0.099692* | -0.3108*** | 0.408711*** | -0.48055*** | -0.16333*** | -0.01706 | 0.446236*** | -0.60798*** | 0.245625*** | 0.013296** |
| plm_nez | -1.33687*** | 0.587884*** | 0.18508 | 0.143609*** | 0.144887** | -0.28361*** | 0.176895 | -0.24235** | -0.18024*** | -0.01489 | 0.410355*** | 0.45604*** | -0.72403*** | -0.00273 |
| plm_os | 3.128014** | -0.98153 | -2.27495 | -2.43473*** | 0.48578 | -0.06009 | 0.653167 | 0.919868 | -0.06043 | -0.11589 | -0.24465 | 1.271339** | -0.14027 | -0.13168 |
| Expenditure Elasticity | -0.00026 | -0.00035 | 0.001697*** | -0.00022*** | 0.000043 | -0.00082*** | -0.00104*** | -0.00015 | -0.0001* | 7.97E-06 | -0.00013** | -0.0001 | 0.000148*** | -2.32E-06 |
| COOL Dummy | -0.10313*** | 0.015759 | 0.021419* | -0.0047 | -0.00146 | 0.02527** | 0.049609*** | 0.006596 | 0.00442** | -0.00205*** | 0.00383** | 0.001227 | -0.00248 | 0.000714*** |

Note: t-values in paranthesis, ***,**,*, implies significant at 1%, 5% & 10% respectively

| Table 5. | Parameter Estimates for Imported Meat products from Major Countries using SD-AIDS model in levels (Pre COOL) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Beef | | | | | | Pork | | | | | Lamb | | |
| Elasticity of | Australia | Canada | New Zealand | Brazil | Uruguay | Other Sources | Canada | Denmark | Poland | Mexico | Other Sources | Australia | New Zealand | Other Sources |
| pbf_aus | -0.05241** | 0.021668 | 0.090284*** | 0.029311*** | 0.076226*** | -0.02734*** | 0.027113** | -0.0053 | -0.00162 | -0.0004 | 0.004602 | -0.10534*** | -0.05037*** | -0.00231*** |
| pbf_can | 0.021668 | 0.186112*** | 0.019632 | -0.00139 | -0.03177*** | 0.029232*** | 0.059506*** | 0.019251*** | 0.016417*** | -0.00319*** | 0.008243** | 0.036569*** | 0.01816*** | 0.000267 |
| pbf_nez | 0.090284*** | 0.019632 | 0.051817** | 0.003972 | 0.019558*** | 0.0389*** | 0.029558** | 0.021733** | 0.022395*** | -0.00246** | 0.008967 | -0.00877 | -0.01071* | -0.28519 |
| pbf_bra | 0.029311*** | -0.00139 | 0.003972 | 0.011254*** | -0.00531*** | 0.010085*** | -0.02151*** | -0.01036*** | 0.001702 | 0.000795*** | -0.00167 | 0.022875*** | 0.007127*** | 0.000196* |
| pbf_uru | 0.076226*** | -0.03177*** | 0.019558*** | -0.00531*** | -0.04483*** | 0.00859*** | -0.00634 | 0.018007*** | 0.003922*** | 0.000078 | 0.005627*** | 0.00803*** | 0.004757*** | 0.000348*** |
| pbf_os | -0.02734*** | 0.029232*** | 0.0389*** | 0.010085*** | 0.00859*** | 0.120261*** | 0.020597*** | 0.013823*** | 0.007549*** | -0.00209*** | 0.008169*** | -0.03588*** | -0.01607*** | -0.00053*** |
| ppo_can | 0.027113** | 0.059506*** | 0.029558** | -0.02151*** | -0.00634 | 0.020597*** | 0.053636*** | 0.044174*** | 0.023143*** | -0.00085 | 0.010269*** | 0.030786*** | 0.012235*** | 0.000709*** |
| ppo_den | -0.0053 | 0.019251*** | 0.021733** | -0.01036*** | 0.018007*** | 0.013823*** | 0.044174*** | 0.020378*** | 0.015007*** | -0.00092 | 0.002542 | -0.02155*** | -0.0072*** | 0.000208 |
| ppo_pol | -0.00162 | 0.016417*** | 0.022395*** | 0.001702 | 0.003922*** | 0.007549*** | 0.023143*** | 0.015007*** | -0.0217*** | -0.0003 | -0.00244 | -0.01023*** | -0.00442*** | -0.00046*** |
| ppo_mex | -0.0004 | -0.00319*** | -0.00246** | 0.000795*** | 0.000078 | -0.00209*** | -0.00085 | -0.00092 | -0.0003 | 0.000242** | -0.00065 | 0.002043 | 0.000469 | 0.000026 |
| ppo_os | 0.004602 | 0.008243** | 0.008967 | -0.00167 | 0.005627*** | 0.008169*** | 0.010269*** | 0.002542 | -0.00244 | -0.00065 | 0.024808*** | -0.01125** | -0.00395** | -0.00022* |
| plm_aus | -0.10534*** | 0.036569*** | -0.00877 | 0.022875*** | 0.00803*** | -0.03588*** | 0.030786*** | -0.02155*** | -0.01023*** | 0.002043 | -0.01125** | 0.009369** | 0.005263** | -0.0002 |
| plm_nez | -0.05037*** | 0.01816*** | -0.01071* | 0.007127*** | 0.004757*** | -0.01607*** | 0.012235*** | -0.0072*** | -0.00442*** | 0.000469 | -0.00395** | 0.005263 | 0.009499*** | 9.84E-06 |
| plm_os | -0.00231*** | 0.000267 | -0.28519 | 0.000196* | 0.000348*** | -0.00053*** | 0.000709*** | 0.000208 | -0.00046*** | 0.000026 | -0.00022* | -0.0002 | 9.84E-06 | 0.000213*** |
| Income Coeff. | 0.996601*** | 0.997578*** | 1.014234*** | 0.996494*** | 1.003414*** | 0.990937*** | 0.993732*** | 0.995344*** | 0.981172*** | 1.019476*** | 0.990277*** | 1.006978*** | 1.010427*** | 1.016885*** |

Note: t-values in paranthesis, ***,**,*, implies significant at 1%, 5% & 10% respectively

**Table 6. Elasticity Estimates for Imported Meat products from Major Countries using SD-AIDS model in levels (Pre COOL)**

| | Beef | | | | | | Pork | | | | | Lamb | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Elasticity of** | **Australia** | **Canada** | **New Zealand** | **Brazil** | **Uruguay** | **Other Sources** | **Canada** | **Denmark** | **Poland** | **Mexico** | **Other Sources** | **Australia** | **New Zealand** | **Other Sources** |
| **pbf_aus** | -1.29148*** | 0.12133 | 0.503608*** | 0.163462*** | 0.424904*** | -0.15196*** | 0.151642** | -0.02935 | -0.00901 | -0.0022 | 0.02572 | -0.58698*** | -0.28065*** | -0.01285*** |
| **pbf_can** | 0.131166 | 0.123271 | 0.118745 | -0.0083 | -0.19163*** | 0.176655*** | 0.359394*** | 0.116264*** | 0.099073*** | -0.01925*** | 0.04978** | 0.22073*** | 0.109619*** | 0.001612 |
| **pbf_nez** | 0.733581*** | 0.157715 | -0.57925*** | 0.031968 | 0.159194*** | 0.315459*** | 0.238786** | 0.17651** | 0.182461*** | -0.02006** | 0.072818* | -0.07207 | -0.08761 | 0.002512 |
| **pbf_bra** | 0.993128*** | -0.0464 | 0.134936 | -0.61882*** | -0.17978*** | 0.341917*** | -0.72786*** | -0.35071*** | 0.057669 | 0.026921*** | -0.05649 | 0.774727*** | 0.241405*** | 0.006626* |
| **pbf_uru** | 3.950376*** | -1.6473*** | 1.013335*** | -0.2754*** | -3.32358*** | 0.444835*** | -0.32906 | 0.93321*** | 0.203282 | 0.004032 | 0.291571*** | 0.416064*** | 0.246484*** | 0.018047*** |
| **pbf_os** | -0.22529*** | 0.244128*** | 0.323985*** | 0.083975*** | 0.071473*** | -0.00073 | 0.172371*** | 0.115175*** | 0.062742*** | -0.01732*** | 0.067988*** | -0.29744*** | -0.13319*** | -0.00441*** |
| **ppo_can** | 0.175356** | 0.383431*** | 0.190711** | -0.04061*** | -0.04061 | 0.133117*** | -0.65435*** | 0.284174*** | 0.148779*** | -0.00545 | 0.066119*** | 0.198089*** | 0.078765*** | 0.004559*** |
| **ppo_den** | -0.10759 | 0.394911*** | 0.445539** | -0.21202*** | 0.368772*** | 0.283571*** | 0.90514*** | -0.58255*** | 0.307305*** | -0.0189 | 0.05213 | -0.44094*** | -0.14729** | 0.004258 |
| **ppo_pol** | -0.16804 | 1.738177*** | 2.369075*** | 0.180445 | 0.414911*** | 0.800066*** | 2.448796*** | 1.586982*** | -3.29284*** | -0.03188 | -0.25756 | -1.08088*** | -0.46665*** | -0.04907*** |
| **ppo_mex** | -0.23675 | -1.88342*** | -1.4499** | 0.467661*** | 0.04551 | -1.23276*** | -0.5036 | -0.54492 | -0.17807 | -0.85757*** | -0.38245 | 1.202547 | 0.275588 | 0.01517 |
| **ppo_os** | 0.225258 | 0.40193** | 0.43668 | -0.08084 | 0.273453*** | 0.397905*** | 0.500248*** | 0.123908 | -0.11845 | -0.03148 | 0.205052** | -0.54576** | -0.19177** | -0.01053** |
| **plm_aus** | -2.57288*** | 0.891559*** | -0.21488 | 0.558224*** | 0.195887*** | -0.87675*** | 0.750452*** | -0.52632*** | -0.24991*** | 0.049857 | -0.27467** | -0.77158*** | 0.128322** | -0.00497 |
| **plm_nez** | -2.28667*** | 0.822041*** | -0.48693* | 0.32298*** | 0.215574*** | -0.73024*** | 0.553394*** | -0.32707*** | -0.20057*** | 0.021237 | -0.17952** | 0.238301** | -0.56937*** | 0.000442 |
| **plm_os** | -5.38282*** | 0.620376 | 0.718691 | 0.456126* | 0.812348*** | -1.24345*** | 1.652098*** | 0.484331 | -1.08406** | 0.060109 | -0.50646* | -0.47533 | 0.022595 | -0.50329*** |
| **Expenditure Elasticity** | -0.00061** | -0.0004 | 0.001746*** | -0.0001 | 0.000066 | -0.00109** | -0.00098** | -0.00023 | -0.00018** | 0.000033* | -0.0002** | 0.000286 | 0.00023* | 7.24E-06 |
| **COOL Dummy** | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |

Note: t-values in paranthesis, ***,**,*, implies significant at 1%, 5% & 10% respectively

**Table 7. Parameter Estimates for Imported Meat products from Major Countries using SD-AIDS model in levels (Post Cool)**

| | Beef | | | | | | Pork | | | | | Lamb | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Elasticity of** | **Australia** | **Canada** | **New Zealand** | **Brazil** | **Uruguay** | **Other Sources** | **Canada** | **Denmark** | **Poland** | **Mexico** | **Other Sources** | **Australia** | **New Zealand** | **Other Sources** |
| **pbf_aus** | 0.07539 | 0.078373** | 0.036033* | -0.0302*** | 0.00108 | 0.003106 | -0.00595 | -0.03572*** | -0.02037*** | -0.00563*** | -0.03184*** | -0.04431** | -0.04447*** | -0.00184 |
| **pbf_can** | 0.078373** | -0.06962*** | -0.00845 | -0.0112*** | 0.003931*** | -0.01783*** | -0.04429** | -0.01294*** | 0.016685*** | 0.004712*** | 0.030645*** | 0.038724*** | 0.010162 | 0.003892** |
| **pbf_nez** | 0.036033* | -0.00845 | -0.03804 | 0.013553** | 0.002542 | -0.01314 | -0.02585 | 0.022907** | 0.003005 | 0.004247*** | 0.002823 | 0.004394 | -0.00279 | -0.00232 |
| **pbf_bra** | -0.0302*** | -0.0112*** | 0.013553** | 0.006705** | 0.001534 | 0.01268*** | -0.00709** | 0.000431 | -0.00079 | 0.000262 | 0.00097 | 0.003289 | 0.007735*** | -0.00092*** |
| **pbf_uru** | 0.00108 | 0.003931*** | 0.002542 | 0.001534 | -0.0155*** | -0.00158 | 0.012285* | -0.00107 | 0.000136 | 0.000982 | -0.00217 | -0.00632 | 0.000936 | -0.00074 |
| **pbf_os** | 0.003106 | -0.01783*** | -0.01314 | 0.01268*** | -0.00158 | 0.093496*** | -0.02452*** | -0.00534*** | -0.00093 | -0.00081*** | -0.00642*** | -0.01813*** | -0.01218*** | -0.00041 |
| **ppo_can** | -0.00595 | -0.04429** | -0.02585 | -0.00709** | 0.012285* | -0.02452*** | 0.083514*** | 0.023907*** | 0.005788 | -0.00201 | -0.00417 | 0.001696 | -0.01966*** | 0.00168 |
| **ppo_den** | -0.03572*** | -0.01294*** | 0.022907** | 0.000431 | -0.00107 | -0.00534*** | 0.023907*** | 0.027252** | -0.01058* | -0.00458** | 0.003861 | -0.00569 | -0.00061 | 0.000662 |
| **ppo_pol** | -0.02037*** | 0.016685*** | 0.003005 | -0.00079 | 0.000136 | -0.00093 | 0.005788 | -0.01058* | -0.00551 | 0.002817* | 0.002383 | 0.005386 | -0.00782*** | -0.00002 |
| **ppo_mex** | -0.00563*** | 0.004712*** | 0.004247*** | 0.000262 | 0.000982 | -0.00081*** | -0.00201 | -0.00458** | 0.002817* | 0.001413 | -0.00051 | 0.000967 | 0.015759* | -0.00259 |
| **ppo_os** | -0.03184*** | 0.030645*** | 0.002823 | 0.00097 | -0.00217 | -0.00642*** | -0.00417 | 0.003861 | 0.002383 | -0.00051 | 0.02287*** | -0.00571 | 0.003556 | -7.29E-06 |
| **plm_aus** | -0.04431** | 0.038724*** | 0.004394 | 0.003289 | -0.00632 | -0.01813*** | 0.001696 | -0.00569 | 0.005386 | 0.000967 | -0.00571 | 0.016759 | 0.008762 | 0.00267** |
| **plm_nez** | -0.04447*** | 0.010162 | -0.00279 | 0.007735*** | 0.000936 | -0.01218*** | -0.01966*** | -0.00061 | -0.00782*** | 0.015759* | 0.003556 | 0.008762 | 0.006383 | -0.00052 |
| **plm_os** | -0.00184 | 0.003892** | -0.00232 | -0.00092*** | -0.00074 | -0.00041 | 0.00168 | 0.000662 | -0.00002 | -0.00259 | -7.29E-06 | 0.00267** | -0.00052 | 0.000417*** |
| **Income Coeff.** | 0.998352*** | 1.004138*** | 1.012224*** | 0.997014*** | 0.999617*** | 0.994545*** | 0.99621*** | 1.000702*** | 0.995435*** | 0.983731*** | 0.993626*** | 0.99306*** | 1.005995*** | 0.945432*** |

Note: t-values in paranthesis, ***,**,*, implies significant at 1%, 5% & 10% respectively

| Table 8. | Elasticity Estimates for Imported Meat products from Major Countries using SD-AIDS model in levels (Post COOL) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Beef | | | | | | Pork | | | | | Lamb | | |
| Elasticity of | Australia | Canada | New Zealand | Brazil | Uruguay | Other Sources | Canada | Denmark | Poland | Mexico | Other Sources | Australia | New Zealand | Other Sources |
| pbf_aus | -0.57952* | 0.437077*** | 0.201032* | -0.1683*** | 0.006049 | 0.017509 | -0.03293 | -0.19901*** | -0.1135*** | -0.03138*** | -0.1774*** | -0.24691** | -0.24783*** | -0.01027 |
| pbf_can | 0.472102*** | -1.42072*** | -0.05147 | -0.0677*** | 0.023637 | -0.10807*** | -0.26787*** | -0.07828** | 0.100625*** | 0.02842*** | 0.184804*** | 0.233462*** | 0.06122 | 0.023478** |
| pbf_nez | 0.291607* | -0.07089 | -1.31164*** | 0.110147** | 0.020489 | -0.10859* | -0.2127 | 0.186178** | 0.024389 | 0.034609*** | 0.02277 | 0.035324 | -0.02305 | -0.01891 |
| pbf_bra | -1.02224*** | -0.37876*** | 0.459298** | -0.77287*** | 0.051996 | 0.429729*** | -0.23963** | 0.014752 | -0.02674 | 0.00888 | 0.032896 | 0.111485 | 0.261965*** | -0.03126*** |
| pbf_uru | 0.056031 | 0.20382 | 0.131799 | 0.079516 | -1.80355*** | -0.08177 | 0.636843 | -0.05539 | 0.007077 | 0.050885 | -0.1125 | -0.32747 | 0.048511 | -0.03814 |
| pbf_os | 0.026758 | -0.14708*** | -0.10837 | 0.105409*** | -0.013 | -0.22332*** | -0.20266*** | -0.04405*** | -0.00763 | -0.00673*** | -0.05318*** | -0.15024*** | -0.10096*** | -0.00343 |
| ppo_can | -0.03758 | -0.28399*** | -0.16567 | -0.04545** | 0.07902* | -0.1571*** | -0.46274*** | 0.153813*** | 0.03723 | -0.01288 | -0.02669 | 0.011056 | -0.12626*** | 0.010797 |
| ppo_den | -0.73149*** | -0.26508** | 0.468913** | 0.008811 | -0.0219 | -0.10941*** | 0.489354*** | -0.44207** | -0.21655* | -0.09367** | 0.079045 | -0.11643 | -0.01244 | 0.013549 |
| ppo_pol | -2.15166*** | 1.76408*** | 0.318188 | -0.08341 | 0.01451 | -0.0973 | 0.612417 | -1.11756* | -1.58214*** | 0.297726* | 0.251901 | 0.5694 | -0.82648*** | -0.00228 |
| ppo_mex | -3.31391*** | 2.778208*** | 2.503894*** | 0.15487 | 0.578597 | -0.47617*** | -1.17867 | -2.69428** | 1.659581* | -0.16779 | -0.30282 | 0.570373 | 9.283574* | -1.5283 |
| ppo_os | -1.54502*** | 1.489384*** | 0.137909 | 0.047283 | -0.10529*** | -0.31106 | -0.20133 | 0.187853 | 0.115777 | -0.02498 | 0.110858 | -0.27717 | 0.172864 | -0.00035 |
| plm_aus | -1.08052** | 0.946471*** | 0.108111 | 0.080491 | -0.15411 | -0.4417*** | 0.042489 | -0.13845 | 0.131547 | 0.023621 | -0.13931 | -0.5906* | 0.214057 | 0.06519* |
| plm_nez | -2.01844*** | 0.45997 | -0.12748 | 0.350669*** | 0.042331 | -0.55316*** | -0.89276*** | -0.02782 | -0.35483*** | 0.714845* | 0.161199 | 0.397221 | -0.71059** | -0.02338 |
| plm_os | -4.28912 | 9.092055** | -5.4041 | -2.15329*** | -1.71637 | -0.95963 | 3.929308 | 1.547248 | -0.04997 | -6.05524 | -0.01589 | 6.234535 | -1.20161 | -0.02639 |
| Expenditure Elasticity | -0.0003 | 0.000686*** | 0.001499*** | -0.00009 | -7.40E-06 | -0.00066*** | -0.00059*** | 0.000034 | -0.00004 | -0.00003*** | -0.00013*** | -0.00028* | 0.000132 | -0.00002** |
| COOL Dummy | 0.077649* | 0.102401*** | 0.123029*** | 0.012619*** | 0.032114*** | 0.08828*** | 0.194127*** | 0.035595*** | 0.020959*** | 0.002897 | -0.004 | 0.141143*** | 0.082718*** | 0.001519 |

Note: t-values in paranthesis, ***,**,*, implies significant at 1%, 5% & 10% respectively