THE EFFECTS OF MANDATORY COUNTRY-OF-ORIGIN LABELING ON

CANADIAN/U.S. LIVE HOG AND FEEDER PIG TRADE

A Thesis

by

SHAD ARTHUR MICHEL THEVENAZ

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

December 2011

Major Subject: Agricultural Economics

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ABSTRACT

The Effects of Mandatory Country-of-Origin Labeling on Canadian/U.S. Live Hog and

Feeder Pig Trade. (December 2011)

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Chair of Advisory Committee: Dr. C. Parr Rosson III

The final implementation of the Mandatory Country-of-Origin Labeling Law has caused some U.S. packing plants and finishing operations to discontinue using Canadian live hogs and feeder pigs in their operations, thereby reducing trade. Using a system of simultaneous equations representing U.S. import demand and U.S. price, this thesis has estimated the reduction in trade and any possible price effects in both live hogs and feeder pigs associated with the implementation of the final rule of Mandatory Country of Origin Labeling in the United States.

It has been found that the implementation of the Mandatory Country of Origin Labeling Law reduced the trade of live hogs between the United States and Canada by 37.8 percent, with the trade of feeder pigs reduced by 24.1 percent. It also has been found that the implementation of the Mandatory Country of Origin Labeling Law has had no effect on the price of both live hogs and feeder pigs in the U.S. market.

ACKNOWLEDGEMENTS

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CHAPTER I

INTRODUCTION AND JUSTIFICATION

The Canadian and U.S. swine industries have evolved over the last few decades into an integrated system. In the late 1980s and early 1990s Canada and the United States solidified trade relationships with the Canadian United States Free Trade Agreement (CUSTA) and the North American Free Trade Agreement (NAFTA).   Over the last two decades there have also been a number of structural changes to the swine industry that produced incentives for greater trade between the United States and Canada. A general trend towards consolidation and specialization in the industry, as well as a need for space to expand, made Canada an attractive alternative for both feeder pig and live hog production growth. This change in production dynamics has altered the industry such that Canada's pork production substantially exceeds domestic consumption.

In 2002 the U.S. Congress passed legislation that could alter the balance of the Canadian U.S. pork trade, this legislation being Mandatory Country-of-Origin Labeling (MCOOL).   The legislation has only recently gone into effect, and many in both countries are concerned that the provisions of MCOOL will alter the well-integrated North American hog trade.

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This thesis follows the style of *The American Journal of Agricultural Economics.*

This thesis analyzes the potential effects of MCOOL on feeder pig and live hog trade between Canada and the United States. Factors influencing the U.S. demand for Canadian live hogs and feeder pigs as well as factors influencing U.S. prices are included in the analysis. The purpose of this study is to quantitatively measure the trade affects associated with the implementation of the MCOOL legislation. What follows is a background of the implementation of MCOOL, a review of selected literature concerning MCOOL, the methodology of the model, results and conclusions.

In 2002 the United States Congress passed the Farm Security and Rural Investment Act, more commonly referred to as the 2002 Farm Bill. It was within this legislation that Congress provided the provision for a mandatory Country of Origin Labeling program. The provisions of the first MCOOL legislation required that most meats, fruits, vegetables and peanuts be labeled with respective country of origin at retail outlets. The terms of the MCOOL legislation stipulated that

> "….a retailer of a covered commodity shall inform consumers, at the final point of sale of the covered commodity to consumers, of the country of origin of the covered commodity" (Farm Security and Rural Investment Act 2002).

The legislation did not, however, require all establishments that serve covered communities to label as to country of origin. The legislation only required labeling in establishments that are defined as retailers in the Perishable Agricultural Commodities Act of 1930. Under this acts definition, retailers must be licensed when the invoice cost of all purchases of perishable agricultural commodities exceeds $230,000 during a calendar year. Only retailers that exceed this amount are required to label covered commodities, thus excluding small butchers, fish markets and restaurants (Agricultural Marketing Services 2009).

Also, covered commodities that are substantially altered or served in an institutional or restaurant setting are not required to carry country of origin labeling. National Pork Board estimations predict that 38% of pork products reach consumers by way of institutions and firms that are not covered by MCOOL and 65% of slaughtered carcasses are transformed into products not covered by MCOOL (Meyer 2008).

Under the 2002 legislation the penalties for non-compliance with MCOOL were large fines for retailers while the legal responsibility for compliance therefore fell solely on retailers. Retailers under the proposed law therefore face a number of new liabilities associated with commodities over which they have no control until final delivery to retail facilities. To mitigate the liability and add legitimacy to the product label, retailers will have to demand a system that gathers, stores and communicates information on the origin of covered communities. This system must permeate through all segments of the supply chain in order for the program to function as designed (Sparks Companies Inc. 2003). In the case of live animals, this burden would entail the development of a credible tracking system that follows animals from birth, through feeding and slaughtering, to the end sale point. The MCOOL legislation also dictated a phase in period of two years during which compliance with the new law would be voluntary in preparation for mandatory labeling which was scheduled to begin in September 2004. Due to a lack of funding, the implementation of MCOOL was delayed several times.   As the 2004 mandatory implementation of MCOOL neared a public debate began to arise. Proponents of the MCOOL legislation defended the legislation as they believed that consumers have a right to know the origin of their food. They also believed that the program would enhance food safety and quality as well as improve domestic prices because of a consumer demand for domestic products. Opponents argued that the MCOOL regulations would be prohibitively expensive,

due to the complexity and mixing involved in current meat supply chains. These opponents also argued that the measures of MCOOL do not provide any information on product safety and that U.S. consumers were not willing to pay premiums for country-of-origin information (Brester, Marsh and Atwood 2004).

After the original start date for mandatory labeling in September 2004, only seafood and shellfish became subject to the rules of MCOOL, all other commodities remained under the voluntary program. A new start date for the mandatory program was scheduled for September of 2006. This date also came and passed without the mandatory program going into effect for all covered commodities as the administration was not yet prepared to enforce the new rules and industry still had many concerns. The law also contained contradictions that made implementation difficult. The MCOOL legislation gave the Secretary of Agriculture the power to request a verified audit trail regarding a covered commodity but granted no power to implement a mandatory identification system (Hayes and Meyer, 2003). Also, Congress precluded funding for MCOOL in both 2004 and 2006. The passage of the FY 2004 Consolidated Appropriation Act and the Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriation Act of 2006 denied funds to implement the MCOOL regulations thereby delaying the implementation of the program until 2009 (Agricultural Marketing Services/USDA 2008).

In 2008, Congress reopened the MCOOL legislation and made some major changes. Modifications to the MCOOL legislation were presented in The Food, Conservation and Energy Act of 2008. The new MCOOL program included a number of new covered commodities such as chicken, which is a key substitute for other meats previously covered under the program. The 2008 legislation also reduced traceability burdens for producers, such as allowing for the use of

affidavits as proof of origin and providing additional provisions for the labeling of meat

products. These new labeling standards were commonly known as categories A, B, C and D,

and are described in Table 1.

Table 1: MCOOL Categories

Category A	Meat from animals born, raised and slaughtered in the U.S. Labeled product of the U.S.
Category B	Meat from animals born in Canada and raised and slaughtered in the U.S. Labeled product of U.S. and Canada.
Category C	Meat from animals born in Canada and raised in Canada and slaughtered in the U.S. Labeled product of Canada and the U.S.
Category D	Meat imported into the United States.

Note: Adapted from (Rude, Iqbal, and Brewin 2006)

Under the new labeling rules Category B and Category C labels would represent

Canadian live animal imports to the United States. In the live hog and feeder pig trade,

Category B would represent feeder pigs that were imported to the United States from Canada

and fed out in the United States, whereas Category C would represent live hogs imported to the

United States from Canada and slaughtered in the United States within 14 days of arrival.

These new labeling categories however did not resolve all labeling concerns as packers

continued to comingle Category B and Category C meat together. The definitions for Category

A and Category D remain less ambiguous (Rude, Gervais and Felt 2010).

In early 2009, the administration released a Final Rule on the implementation of

MCOOL. In the final ruling it became clear that country-of-origin labeling would convert from a

voluntary system to a mandatory system. In February of the same year it was announced that

the full MCOOL program would be implemented on March 16th, 2009. It was predicted that the full implementation of MCOOL would have a significant structural effect on the integrated live hog and pig market that has developed in North America.

Over the last two decades, a change in both the U.S. and Canadian pork industries has led to growth in the number of feeder pigs and slaughter hogs exported from Canada to the United States. The trade is one way in direction whereby the amount of reciprocal trade in this category of livestock is almost non-existent. Canada imports very few feeder pigs or hogs from the United States. On average, the trade between these two countries has been divided two thirds feeder pigs and one third slaughter hogs. The majority of the feeder pigs are exported to feed grain producing states such as Iowa, Kansas, Missouri, Nebraska, Illinois, Indian, Michigan, Minnesota, Ohio and Wisconsin. The majority of slaughter hogs are exported to areas that have a deficit in hog production such as Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming, Arizona, California, Hawaii and Nevada. The U.S. slaughter is comprised of approximately 6 percent imported Canadian hogs and pigs annually (Haley 2004a).

Structural changes in the U. S. hog industry were key in creating an integrated U.S./Canadian system over the past decade. In the mid-1980s the U.S. hog industry transitioned from small operations to large, specialized supply chains. Prior to the 1980s, the U.S. hog industry was dominated by small operations that practiced mixed farming. These small farms were farrow-to-finish operations, where the animals were both bred and fed to market weight at the same locations. In the late 1980s and early 1990s the industry shifted towards larger specialized operations that focused on either farrowing pigs or finishing operations. This shift in production style was propagated by a change in payment methods

where contract production became standard, as well as shifts in technologies that favored large scale and specialized production (Key and McBride 2007).

This switch to contract production not only led to the development of larger operations, it also created incentives for the expansion of hog production in non-traditional production areas of the United-States. North Carolina was the prime example of expansion in a non-traditional area. Shortly after the growth however, the North Carolina expansion had to be halted due to concerns over environmental issues and the proximity of large hog operations to highly populated areas. The slowdown in growth due to environmental concerns lead to expansions in areas with large amounts of open space that could better manage both environmental concerns, waste management issues and locate production far from highly populated areas. The net results of these changes were an expansion of production (Key and McBride 2007).

The growth in production was not limited to the United States. The trade liberalization that followed the CUSTA and NAFTA agreements allowed for increased trade which led to growth in Canada as well. Major government policy shifts also led to an expansion of the Canadian industry. One of the Canadian obligations under the Uruguay Round Agreement on Agriculture was the elimination of the Western Grain Transportation Act (WGTA). This act subsidized the transport of grains from major production areas in the prairies to major ports on both the Canadian east and west coast. The elimination of the WGTA made transporting grain expensive and provided incentives for livestock producers to relocate to the Prairie Provinces where a supply of lower cost grain had become available (Hahn, Haley, Leuck, Miller, Perry, Taha and Zahniser 2005). This feed cost advantage coupled with the abundance of space and superior disease prevention, created opportunities for large expansions in hog production in

Canada which fit in well with the new U.S. contract system (Agriculture and Agri-food Canada, 1997).

Over the same time period, the United States and Canada continued to solidify their bi-lateral and international free trade agreements, creating an environment favorable to cross border trade. The CUSTA and NAFTA agreements created for Canada an environment with few trade restrictions between the two countries. After CUSTA and NAFTA, the sole restrictions in the swine industry were based on health restrictions and frictions in the two legal systems, and not trade distorting policies (Hobbs and Kerr 2007). This environment of free trade enabled both U.S. packing plants and finishing operations to take advantage of Canadian surpluses and comparative advantages. U.S. packers began to consistently "outbid" Canadian packers for slaughter hogs. This outbidding was made possible by lower wages and flexible work rules in the United States. These cost differences made for wider packer margins in the United States and an increased demand for Canadian slaughter hogs by U.S. packers (Haley 2004b). Finishing operations in feed heavy areas such as the Corn Belt, under the free trade regime, gained access to a large supply of hearty feeder pigs from Canada.

The trade of live slaughter hogs and feeder pigs in the middle part of the last decade also increased due to events in the live cattle trade between the United States and Canada. Beef is one of the main substitutes for pork and as such, drastic changes in the North American cattle trade can alter the North American hog trade. In May 2003, the U.S. Canadian border was closed to the trade of live cattle in response to a case of bovine spongiform encephalopathy (BSE) discovered in Alberta. This event had a drastic effect on the beef industry in both Canada and the United States. Like the hog industry, a large portion of the cattle raised in Canada is earmarked for U.S. packers. Hence, when the border was closed, the

Canadian market faced a substantial cattle surplus. The opposite occurred in the United States; the closure of the border caused a shortage of cattle, thereby raising the price of beef (Southard 2003b).

In Canada, the excess supply caused beef retail prices to fall, making pork seem more expensive in comparison to beef. Canadian consumers responded by consuming less pork and more beef. The decrease in Canadian demand for pork caused Canadian pork packers to scale back production and demand fewer hogs. The decrease in demand caused a number of small Canadian packers to close which in turn increased the number of animals available for export.

The opposite effect occurred in the United States. The reduced slaughter cattle supply made beef products more expensive relative to pork. Hence, U.S. consumers began to demand more pork as a substitute for beef. In response to an increase in the demand for pork, U.S. packers demanded more hogs. The trade in live hogs was not halted because of BSE so U.S. packers had a supply of readily available slaughter hogs in Canada. Since these hogs were no longer being slaughtered in Canada, U.S. packers were able to use excess Canadian supply to meet growing demand for pork. Therefore, because of BSE, there is a noticeable increase in the trade of live hogs and pigs immediately after the discovery of BSE in Canada (Southard 2003b).

The implementation of MCOOL has the potential to disrupt the integrated North American swine market that has developed over the last two decades. The difficulties involved with the MCOOL program concerning the live hog and feeder pig trade between Canada and the United States centers mostly around the packing industry and the issue of traceability. Under the terms of MCOOL, covered commodities must be labeled with the country-of-origin at retail. Hence there must be some system of reliable traceability that follows the animals as

they move through various portions of the supply chain. Under pre MCOOL rules, imported

commodities had to be labeled to country of origin to the "ultimate purchaser" of the original

product. In the case of livestock, under the pre MCOOL regulations, the ultimate purchaser was

usually the slaughter house or finisher (Krissoff, Kuchler, Nelson, Perry and Somwar 2004). The

general practice in the industry is to mix Canadian hogs and U. S. hogs as if they are a

homogeneous product. Once the product reaches the slaughterhouse or the finisher the

information chain is broken as slaughterers treat animals from both Canada and the United

States the same, disregarding the origin of the animal. Under the rules of MCOOL, processors

that use both Canadian and U.S. product will have to alter these practices of mixing Canadian

and U.S. hogs.

The current industry standard of mixing will have to be replaced by a system of

segregation and traceability in order to meet the MCOOL regulations. For packers that only

deal with animals born and finished in the United States the new regulations will not add

substantial costs especially since the regulations for identification were amended in 2008. The

cost of implementing MCOOL will be directly linked to the packers' decision on whether to

accept Canadian animals or not (Sparks Companies Inc. 2003). For packers who use Canadian

slaughter hogs in their operation, extra costs associated with segregation and identification will

be incurred. Estimates of these costs have varied substantially depending on assumptions

made and which MCOOL regulations are considered. Regardless, there is a general consensus

that using mixed origin animals will increase the cost of production and thereby reduce packer

margins for those firms using imported animals. This has many concerned that packers will

take the path of least resistance and accept only U.S. hogs (Informa Economics 2010). Such a

reduction in demand by U.S. packers for Canadian hogs would lead to a reduction in trade and lower prices in Canada.

There are some suggestions that the decrease in demand for Canadian hogs can be offset if the imported animals are used to meet demand in the institutional and service industry or in processed pork products, since these areas do not require a MCOOL label. The Hotel, Restaurant and Institutional (HRI) is the fastest growing demand for red meat sector in the United States and products marked for this sector would not require MCOOL labeling (Rude, Iqbal and Brewin 2006). This prospect also has significant cost associated with MCOOL. In many cases the final destination of a product is undetermined, whether it will eventually be sold for use at home, the HRI sector or used for exports is an unknown. Unless, a firm wants to limit itself to only the export and HRI sector, all products no matter final destination will have to follow MCOOL regulations when leaving the packing facility (Sparks Companies Inc. 2003).

The purchasing decisions of finishers will directly depend on the purchasing decision of packers. At the feeder level, operations should face little increases in segregation cost as it is already industry practice to separate animals for management and health reasons (Informa Economics 2010). There could be some additional cost associated with improved record keeping requirements; however those should not be substantial. The real decision factor for these finishing firms is dependent on packers' willingness to accept Canadian born animals which are fed out in the United States. If packers are unwilling to accept Canadian origin hogs, then U.S. finishers will no longer demand Canadian born pigs (Grier, Martin, Mayer 2002).

These possible trade disruptions have many industry and Government entities on both sides of the border very worried. Industry groups such as the American Meat Institute have lobbied Congress on the issue of MCOOL with concerns that the legislation will negatively affect

not only the pork but beef industry as well. Canadian diplomats have also lobbied the United

States with concerns surrounding the legislation. Both the industry as well as the Canadian

government, believes that the current MCOOL legislation is in violation of existing trade

agreements. In response to this the Canadian government has launched a case at the World

Trade Organization (WTO) concerning the matter of MCOOL. There are a number of provisions

in the GATT agreement that do allow for marks of origin however those agreements have yet to

be tested in a WTO dispute panel. The Canadian Government does not stand alone in this

dispute with the U.S. over MCOOL regulations. Shortly after Canada launched its case with the

WTO Mexico launched a petition citing similar concerns (Sawka and Kerr 2010).

CHAPTER II

LITERATURE REVIEW

In their 2010 paper concerning the impacts of MCOOL on the U.S. /Canada bilateral hog and pork trade Rude, Gervais and Felt divided the literature on MCOOL into four distinct categories. These categories being: consumers' willingness to pay for country-of-origin information, quality signaling through labeling, market effects and welfare implications, and finally econometric tests of impacts on markets (Rude, Gervais and Felt 2010). These same four categories will be used for the literature review in this paper. The first category to be considered is consumers' willingness to pay for country-of-origin labeled products. Many proponents of the MCOOL legislation believe that consumers demand the information associated with MCOOL and are willing to pay a premium for the information. The literature is mixed on whether this statement is valid.

In 2009, Menapace, Colson, Grebitus and Facendola conducted a study on consumers' willingness to pay for products with country-of-origin information and geographical indicators. The paper adopted a multinomial mixed logit model to explain consumers' choices when purchasing olive oil. When comparing Italian Olive Oil to Spanish Olive Oil, it was found 81 percent to 86 percent of Canadian consumers, depending on the model used, preferred Italian Olive Oil and would pay a premium ranging from 7.68 to 9.48 CAD$/Liter.   This finding that consumers do have a willingness to pay for perceived higher quality consumer goods such as olive oil from certain countries supports the thesis that consumers do value geographical origin labels for their ability to provide information regarding the quality. The study used survey data

taken from a number of Canadian retail establishments (Menapace, Colson, Grebitus and Facendola 2009).

In 2002, Umberger, Feuz, Calkins and Sitz used experimental auction data to predict consumers' willingness to pay for MCOOL covered U.S. beef products. The study conducted surveys and experimental auctions to elicit consumers' willingness-to-pay for origin information. The surveys and auctions were conducted in both Denver and Chicago. It was found that consumers were willing to pay a 19 percent premium for steak labeled "Guaranteed USA: Born and Raised in the US." The authors also found that 73 percent of respondents were willing to pay an 11 percent and 24 percent premium for origin labeling associated with steak and hamburger respectively (Umberger, Feuz, Calkins and Sitz 2003).

Loureiro and Umberger in 2002 also used survey data to econometrically estimate consumers' willingness to pay for MCOOL. A consumer survey was conducted in several grocery stores in the Colorado cities of Boulder, Denver and Fort Collins. The authors used logit models centered on the survey data to determine consumer willingness to pay for MCOOL. The authors found that on average, households were willing to pay $184 for a mandatory country-of-origin labeling program. It was also found that on average consumers were willing to pay $1.53 and $0.70 per pound in premiums for steak and hamburger labeled as "U.S. Certified Steak" and "U.S. Certified Hamburger." These premiums represent a 38 percent and 58 percent increase in the price of steak and hamburger respectively (Loureiro and Umberger 2003).

The second group of MCOOL literature examines quality signaling associated with labeling. In 2004 Zago and Pick conducted a study using vertical differentiation to determine the effects of origin signaling on both market equilibrium and total welfare. The study was not

based on MCOOL regulations but rather regulations in Europe that also signal quality. The

authors examined the emergence of separate markets created by government regulations in

labeling. The study focused on both high quality producers and low quality producers and

found that the high quality producers were better off with the introduction of labeling. Low-

quality producers were found to be worse off and it was possible for the total welfare to be

negative in response to the labeling regulation (Zago and Pick 2004).

Research done by Joseph, Lavoie and Caswell in 2009 showed the possible signaling

effects of not including the HRI sector in the MCOOL program and used the U.S. seafood

industry to characterize these effects.   The authors found that by excluding the HRI sector from

the labeling program there were a number of incentives for producers to divert lower quality

products from developing countries to the HRI sector. While the MCOOL labeling fulfills the

signaling demands in one sector, the exceptions of MCOOL requirements in other sectors

create incentives for the diversion of imports that might be considered of lesser quality. The

authors also found that consumer welfare and total welfare is greater under a voluntary system

as compared to a mandatory one (Joseph, Lavoie and Caswell 2009).

In their 2007 work Plastina and Giannakas consider the signaling effects of MCOOL in

two specialty crops: apples and tomatoes. The authors found that only some consumers would

benefit from the signaling qualities associated with MCOOL regulations. Once heterogeneity is

assumed for all consumers, it was found that only a select few consumers benefit from a

mandatory program, mainly those with very strong or very weak demand for origin

information. The authors found that consumer demand would have to increase by 2.6 percent

to 7.0 percent in the case of apples and 8.2 percent to 22.4 percent in the case of tomatoes, in

order to offset the implementation costs of MCOOL (Plastina and Giannakas 2007).

In 2005 Dinopoulos, Livanis and West developed a partial equilibrium model representing a theoretically small open economy producing a safe product and importing unsafe products in a perfectly competitive market. The authors assert that MCOOL could solve the information problem associated with trade in potentially unsafe food products. The paper also assumes that there is a difference between the market price and the risk adjusted price (RAP) of consumers. In the model it is assumed that all products are labeled, no matter their final point of sale and their origin. With the information associated with MCOOL, consumers would be willing to pay the RAP price for food that is associated with safe production locations thereby increasing consumer welfare. The authors never address the fact that MCOOL only covers imports sold in certain establishments and not all imports of all covered commodities (Dinopoulos, Livanis and West 2005).

While not directly related to MCOOL, in 2004 Bulut and Lawrence conducted research on the costs of implementing full traceability at slaughter plants in Iowa. The use of a full traceability system was a possibility under the original terms of the MCOOL in the 2002 Farm Bill. The authors are quick to note that currently there is no uniform traceability system that is monitored by the U.S. Food and Drug Administration (FDA) or the United States Department Administration (USDA). The study examined the factors that would lead to the voluntary adoption of traceability in slaughter plants in Iowa. It was found that traceability was more difficult to implement for larger firms because these large operations source animals from a number of different producers. It was also found that firms producing a branded product were less likely to voluntarily implement traceability because the firm used the brand to convey quality information. On the other hand, the research showed that facilities owned by large corporations were more likely to adopt stringent traceability rules as a means of protecting

against reputation loss. The authors agreed with much of the literature on traceability,

concluding that the cost of any move towards a unified traceability system would fall heavily on

packers (Bulut and Lawrence 2008).

The third string of literature deals specifically with the direct market and welfare

effects of MCOOL legislation. This area of literature is the most developed and contains the

majority of bodies of work and studies pertaining to the U.S. mandatory labeling program. In

2004 the ERS of the USDA released a report outlining the potential market effects of MCOOL.

The authors, Krissoff, Kuchler, Nelson, Perry and Somwaru, begin the report by inferring that

since there is no voluntary program to date, either the majority of consumers do not demand

the information contained in country-of-origin labeling, or there is a market failure. If there

was money to be made from labeling, there would already be a private system; the current

market structure prevents consumers from receiving this desired information. The authors

analyze both possibilities for a lack of labeling and by using a general equilibrium model, predict

that MCOOL will reduce production and raise prices for most covered commodities. The paper

also concludes that since the program will affect supply and demand relationships, there will be

an effect on trade. If the MCOOL requirements increase costs, consumers might move towards

cheaper imports. If it is difficult to prove origin, however, suppliers will move away from

imports to avoid segregation costs (Krissoff, Kuchler, Nelson, Perry and Somwar 2004).

In 2003, Hayes and Meyer conducted a study to determine the cost of implementing

MCOOL on the U.S. pork industry. The authors used two models to determine the costs of

implementing the MCOOL program; the first being a trace back system similar to systems used

in the EU and a certification system that is less strenuous as compared to trace back. The

authors found that a trace back system would increase fixed costs by $3.00 a head and variable

costs by $23.00 per head in the pork industry. It was also found that cost would increase by

$1.50 per head for capital and $4.60 per head for labor. Under the certification system, costs

would be significantly less as identification would not have to follow every animal through

every stage of production, thereby eliminating the need to maintain identification for a

majority of products. The model constructed by the authors also predicts that hog exports

from Canada could fall by 50 percent because of the segregation costs associated with MCOOL

(Hayes and Meyer 2003).

In 2002 Kerr presented a paper that looked at the possible effects of MCOOL on the

NAFTA partners. In his paper, Kerr predicted the costs of implementing MCOOL labeling for

table ready goods would be less for Canada and Mexico, as compared to the U.S., as these

countries would not need to maintain identification within their respective borders. Table-

ready products from these countries would be labeled as product of Canada or Mexico.

Animals used in U.S. table ready products, however, would need to maintain identity

throughout all levels of production if a trace-back system is adopted. Because of this cost

increase created by MCOOL legislation, the author predicts that the preferred exports from

Canada in the pork industry will be table ready products, representing a reversal from current

trading patterns. This could eventually lead to an expansion of Canadian packing capacity and

shortages in U.S. slaughter facilities (Kerr 2003).

In 2002, the George Morris Center, a Canadian agricultural think tank, released a report

outlining the possible effects of MCOOL legislation on the Manitoba hog industry. According to

the authors, Grier, Martin and Mayer, the implementation of MCOOL could have far reaching

structural effects on the Manitoba markets such as the loss of 450 farms, reduction of 250,000

acres of cropland and grain production losses totaling $750 million. The authors also believe

that costs to the U.S. pork industry will increase regardless of whether U.S. firms continue to accept Canadian hogs and pigs. The authors also constructed a model that predicts that 80 percent of the variation in pork price can be explained by changes in slaughter, therefore any change in Canadian exports could have a price effect in the U.S.

Finally, the George Morris Center report considers three possible scenarios for Canada associated with the implementation of MCOOL. The first of these scenarios is one where U.S. packers and finishers refuse to take Canadian live exports and U.S. retailers refuse to accept Canadian pork because of concerns over shelf space. If this occurs, the result would be a shortage of animals in the U.S., and a surplus in Canada rendering Canadian pigs practically worthless. The second scenario is one in which the U.S. and Canadian markets can adjust to the new program and there is no structural change. The final scenario suggests U.S. finishers and packers would decide to stop importing live hogs and pigs, but retailers would find Canadian pork products inexpensive. This final scenario would lead to an expansion of Canadian packing capacity and an increase in the trade of table ready pork (Grier, Martin and Mayer 2002).

In 2004 Brester, Marsh, Atwood studied the distributional effects of MCOOL on the U.S. meat industry. The authors construct an equilibrium displacement model that incorporates previous estimated costs of MCOOL, interrelationships along the market chain and substitutability among meat products at the consumer level. The model assumes that the cost of MCOOL will fall on suppliers and little demand reaction by consumers; hence conceptually only a shift in the supply curves in the pork industry. The results indicated that the introduction of MCOOL would increase the price of pork; however quantities of pork at both the wholesale and retail level would decrease. The model also found that without any change in consumer demand associated with the new labeling laws, all producers in the supply chain would suffer a

decrease in producer surplus. The model considers both the short and long run effects of implementing MCOOL, and while both temporal models had similar results, the more elastic long run models had smaller percentage changes for all variables. Of note in the pork industry, in a model that assumes no change in demand associated with MCOOL, the percentage changes in the retail pork price was 0.77 and 0.16 in the short and long run respectively. In the retail pork quantity the percentage change was -0.12 and -0.05 in the short and long run respectively. In the wholesale pork market the percentage change in price was found to be 2.98 in the short run and 1.31 in the long run and the percentage change in quantity was found to be -2.13 and -0.96 in the short and long respectively. Finally in the hog market, the percentage change in price was -1.17 in the short run and 0.05 in the long run and -1.54 and -0.98 in the short and long run respectively for hog quantity (Brester, Marsh and Atwood 2004).

In 2006, Rude, Iqbal and Brewin constructed a partial equilibrium non-spatial model to determine the effects of MCOOL on the North American pork industry. As with other studies, the authors made the assumption that the costs of MCOOL would increase transaction costs throughout the entire supply chain. The model divided the supply chain into both pork and hog exports from Canada into the U.S. The authors found that the implementation of MCOOL would increase the price of retail pork in the U.S. thereby discouraging consumption. It was also found that producer prices fell, creating incentives for reducing hog production. As for Canada, the authors found that besides a shift in trade flows; the impact on the rest of the Canadian market is relatively small. The authors do predict that if U.S. packers refuse Canadian live hogs, the price linkage between the Canadian hog price and the U.S. hog price would be disconnected and Canada would begin to export more pork to the rest of the world (Rude, Iqbal and Brewin 2006).

In 2004, Lusk and Anderson used an equilibrium displacement model which included the producer, wholesale, and retail markets for beef, pork and poultry production to evaluate the welfare effects of MCOOL. The paper found that as the costs of MCOOL are shifted from producers to processors and retailers, producers are made increasingly better off while consumers are made increasingly worse off. The model captures the supply chain relationship in the industry by incorporating numerous levels of production as well as the ability of consumers to switch between different types of meat. After examining a number of different scenarios, the authors found that an increase in production costs due to MCOOL always decreased consumer surplus. It was also found that the more cost was concentrated on retailers and processors, consumers were increasingly made worse off. The authors also found that the effects of MCOOL were also concentrated on those packers in the northern United States that depend on Canadian exports (Lusk and Anderson 2004).

In 2009 Chung, Zhang and Peel found very similar results to Lusk and Anderson by using another equilibrium displacement model. The study examines changes in the equilibrium conditions for the beef, pork and chicken industries caused by the implementation of MCOOL legislation. The authors determined that without a significant increase in domestic demand, producers are not expected to benefit from MCOOL implementation (Chung, Zhang and Peel 2009).

In 2003 Sparks Companies Inc. released their estimates on the costs of implementing MCOOL. It was these estimates that many authors used in studies as the costs of implementing the MCOOL program. The Sparks report predicted that a full traceability system would need to be implemented to meet the requirements of the 2002 legislation. The Sparks report also found that the costs associated with pork products would be less than beef because much of a

hog carcass is converted into non MCOOL covered products. Costs would still however be significant, especially for operations that use mixed origin input hogs. Therefore costs would be greater for pork production that uses a number of input sources as compared to those packers that do not use Canadian supply or source from a number of different finishing operations (Sparks 2003).

The previously mentioned studies were all conducted with the original rules of MCOOL in mind and therefore do not consider changes to the program made in the 2008 Farm Bill and Final Rule. In 2009, Informa Economics released their new estimates of the costs of implementing MCOOL based on the 2008 rules. According to the report, the costs of implementing MCOOL in the pork industry were significantly reduced by the changes of 2008. The use of affidavits to certify animals as being of U.S. origin would allow certain supply chains to completely surpass many of the costs associated with MCOOL. However the authors predicted that there would still be significant costs associated with supply chains that decide to use mixed origin live hogs and feeder pigs. The report places most of the cost of implementing MCOOL on U.S. packers (Informa 2010).

In 2009 Carlberg, Brewin and Rude took a theoretical approach and analyzed the effects of MCOOL on the Canadian Beef Industry. The authors found that the majority of the costs associated with implementing MCOOL in the beef market will be paid by packers and hence segregation in packing plants will most likely occur. This segregation would be similar to the segregation that is also predicted for the pork industry (Carlberg, Brewin and Rude 2009).

The final stream of literature associated with MCOOL involves using econometrics to test for actual changes occurring because of MCOOL. All the previous literature viewed is predictive in nature and are estimates of possible reactions to the program. This last category

of works tries to measure the actual results of MCOOL after implementation. Since the actual

implementation of MCOOL has only occurred recently, literature in this area is limitedly

available.

In 2010, Wozniak conducted a study that measures the changes in U.S. consumption of

salmon after MCOOL implementation. There is an underlying assumption in the study

concerning markets. This assumption believes that markets that perform well will provide all

desired information. The study uses a nonlinear AIDS model to estimate the demand for 3

salmon products: precooked, uncooked fresh and uncooked frozen. The authors found that

MCOOL had no effect on the consumption in the U.S. market. This leads the author to the

conclusion that the salmon market was preforming efficiently before the implementation of

MCOOL (Wozniak 2010).

In 2010 Rude, Gervais and Felt use econometric models to try to locate structural

breaks in the live hog and feeder pig trade between the United States and Canada and

determine if any of these breaks occurred in conjunction with MCOOL legislation. The authors

maintain that reaction to MCOOL might not occur exactly when the program was implemented,

as market participants change their production habits in preparation of the program

implementation. The authors determined that MCOOL could be a factor in structural change in

the live hog trade, but it was difficult to pinpoint structural changes associated with MCOOL in

the feeder pig and pork trade (Rude, Gervais and Felt 2010).

The main point in this literature review is the potential structural changes that MCOOL

could have on the Canadian/U.S. trade in live hogs and feeder pigs. Even though it seems like a

simple proposition to label food products to origin, the integrated supply chain that uses both

U.S. and Canadian born pigs makes labeling both a difficult and expensive task. An aversion to

these new costs and the possibility of segregation will have a negative impact on trade. It is

also clear from the literature that the majority of these changes to trade will occur in the live

hog and pig trade. The task of labeling table ready products made in Canada and sold in the

United States is a simpler proposition than tracking animals through an integrated supply chain.

It would seem that changes to the trade in pork will take some time to materialize as firms

react to the new legislation; however changes in the pig and hog trade will happen more

immediately as firms avoid paying extra production costs.

Another main question in the literature involves the market in general and its ability to

provide all information demanded by consumers. It is still uncertain whether consumers do

actually demand origin information. Where survey studies do claim that consumers are willing

to pay for origin information, econometric analysis has shown that consumer consumption has

not been affected by the implementation of MCOOL. This leads to the question of whether

there is a market failure that needs correction and if so, why is this failure only present in the at

home consumption market?

CHAPTER III

METHODOLOGY AND DATA

The methodology used in this study is based on work done by Wachenheim, Mattson and Koo in 2004. In their work, the authors use a system of simultaneous equations to estimate trade flows between the United States and Canada of beef, cattle, hog and pork, using data spanning the years 1981 to 1999. The model used in this paper is an adaptation of the Wachenheim et al. study.

This model will focus on trade in live hogs and feeder pigs. Before MCOOL was implemented, U.S. custom regulations stated that products must be labelled with origin to the last customer who will use the product in its traded form, before major alterations. Table ready pork products that are exported from Canada to the United States are in a consumer ready form and therefore can easily be labelled with origin information. These table ready pork products are easily verified and labelled product of Canada. It will also be easy to verify and maintain origin information of frozen pork cuts that come across the border as Canadian slaughters use Canadian born and fed hogs in their production. However, the regulations of MCOOL do alter the labelling requirements concerning the trade of live hogs and feeder pigs. Under the MCOOL regulations, the origin of these animals must no longer only be tracked to first user, but all the way to the final retail establishment. There is also no evidence to suggest that U.S. consumers value Canadian pork less than U.S. pork, and that U.S. consumers will shy away from labelled Canadian products. It is therefore assumed that the major structural changes to the market in relation to MCOOL will occur in the live hog and feeder pig trade, and

any changes that may occur in the pork trade, in relation to MCOOL, are caused by structural

changes in the live hog and feeder pig trade.

The model also assumes that only the U.S. and Canada trade in live hogs and feeder

pigs. Over the estimated period, on average, Canada exported 184,197 head of hogs to the

United States per month. Canada imported on average only 549 head of hogs per month from

the United States. In the feeder pig trade, Canada on average exported 416,148 head per

month to the United States, where as the United States exported only 283 head of feeder pigs

to Canada on average to the United States.

Where both the U.S. and Canada are large players in the international pork market, the

majority of international pork trade is done in frozen pork cuts and not live animals. The

international trade of live animals is limited by the difficulty and cost of transporting them

overseas. The flow of live hogs and feeder pigs' trade is also uni-directional, from Canada to

the U.S. The surplus of live animals in Canada, and the excess slaughter capacity in the U.S.,

creates a system whereby the majority of animals flow south. Canada does import a small

number of animals from the U.S., but these animals are used primarily for breeding stock.

The Wachenheim, Mattson and Koo model specifies a U.S. import demand equation

and a Canadian export demand equation that has been modified for this study. The Canadian

export supply equation and the U.S. import demand equation are specified as:

1. $M_t = f\left(P_t^{us}, RER_t, USINV_t, BSE, K, Y_t, M_{t_{-1}}, D_t\right)$: U.S. Import Demand

2. $X_t = f\left(P_t^{US}, P_t^{C}, RER_t, CANINV_t, X_{t_{-1}}, D_t\right)$: Canadian Export Supply

The definitions of all the variables are presented in Table 2.

Table 2: Trade Equations Variables

M	The number of imports of live hogs or feeder pigs into the United-States
X	The number of exports of live hogs or feeder pigs out of Canada
P^{US}	The price of live hogs or feeder pigs in the United-States
P^C	The price of live hogs or feeder pigs in Canada
RER	The real exchange rate between the U.S. Dollar and the Canadian Dollar measured as Canadian Dollars per one U.S. Dollar
$USINV$	Inventory of live hogs or feeder pigs in the United States
$CANINV$	Inventory of live hogs or feeder pigs in Canada
BSE	Dummy variable representing the closure of the U.S. border to live cattle imports from Canada
K	Dummy variable representing the implementation of the Final Rules of MCOOL
Y	Disposable income in the United States
D	Seasonal dummy variables
M_{t-1}	Lagged dependent variable, imports
X_{t-1}	Lagged dependent variable, exports

In the U.S. import demand equation, it is expected that as the U.S. price of hogs and pigs falls, the number of imports will increase. The U.S. price is assumed to be the world price as well, so as the world price falls, imports will increase. The real exchange rate is expected to have a positive effect on imports. As the real exchange rate increases, importers will be able to buy more Canadian dollars for every U.S. dollar, resulting in lower prices of Canadian goods.

The U.S. hog inventory should have a negative influence on imports. Imports from Canada are used to complement shortages in the U.S. inventories. If the U.S. inventory is low,

packers and feeders will demand more Canadian animals to supplement the difference. The

dummy variable BSE should have a positive effect on imports. The border closure to live cattle

caused a deficit of slaughter cattle in the U.S., causing the price of beef to increase. Since pork

is a substitute for beef, the increase in the price of beef caused an increase in demand for pork.

U.S. packers filled this demand with animals from Canada. The dummy variable takes on a

value of 1 for every month the border was closed, May 2003 to November 2007. The

coefficient associated with the MCOOL dummy variable should be negative because the

regulations of MCOOL caused some U.S. packers and feeders to no longer accept Canadian

inputs. The MCOOL dummy variable takes on a value of 1 for every month beginning in March

2009 when the final rules of MCOOL where implemented till the end of the data set. It is

expected that as income increases, imports will also increase and therefore the income variable

should be positive. Finally, lagged dependent variables are added to capture dynamic effects of

the market and are expected to be positive. There are also eleven dummy variables

representing the months of the year to capture any seasonality. The sign of these variables is

ambiguous (Wachenheim, Mattson and Koo 2004).

The U.S. hog and pig price will have a positive effect on the Canadian export supply

curve. As the world price goes up Canadian producers will supply more exports. The sign of the

Canadian hog price should be negative because as non-export prices goes up, Canadian

producers will sell to the domestic market. The real exchange rate will be negatively associated

with exports. As the U.S. dollar gets weaker, exporters will receive less as compared to what

could be earned in Canada. As the Canadian inventory increases, so does the amount of

available exports, hence the inventory variable should have a positive sign. Again there is a

lagged dependent variable to capture dynamic effects and seasonal dummy variables.

The current model also takes into consideration the biological nature of the live hog

and feeder pig market. Market participants cannot react instantaneously to market changes by

altering supply. If a finisher wants to produce more slaughter hogs because of higher prices,

this finisher cannot supply these animals right away. It takes approximately 6 months for a pig

to be born, fattened and readied for market. At the same time, if a pig producer wishes to

supply more feeder pigs to finishers because of changes in the market, he cannot do so right

away because it takes some time to breed and produce the animals (Parcell, Mintert and Plain

2004).

The literature has predicted that the implementation of MCOOL might not only have an

impact on trade, but a domestic price effect as well. It is also plausible that the events of BSE

had an effect on the prices of live hogs and pigs. As such a price equation is specified:

3. $P_t^{US} = f(M_{t,} P_{t,}^D USINV_t, BSE, K, P_{t_{-1}}^{US}, D_t, T_t)$

The definition of the price equation variables can be found in Table 3.

Table 3: Price Equations Variables

P^{US}	The price of live hogs or feeder pigs in the United-States
M	The amount of imports of live hogs or feeder pigs into the United-States
P^D	Price acting liking complements. In the case of hogs, the futures price and in the case of pigs, hog price.
$USINV$	Inventory of live hogs or feeder pigs in the United-States
BSE	Dummy variable representing the closure of the American border to live cattle imports
K	Dummy variable representing the implementation of the Final Rules for MCOOL
P^{US}_{t-1}	Lagged dependent variable, US price
D	Seasonal dummy variables
T_t	Variable representing Trend

It is predicted that an increase in imports will decrease the U.S. price as imports increase domestic supply. The complementary price will be positive for both live hogs and feeder pigs. In the case of live hogs, the hog price follows closely the futures price and therefore both prices should move in the same direction. In the case of feeder pig, as the price of hogs' increases, the price of feeder pigs will also increase as the demand for feeder pigs is a derived demand of slaughter hogs. The signs on both the BSE and K dummy variable will be ambiguous depending on how prices react to these structural changes. Lagged dependent variables are added to capture dynamic effects of the model and are expected to be positive. Seasonal dummy variables are added to capture any possible seasonality in prices. Finally a trend variable is added to capture any permanent upward or downward movement in the data.

Since there are only two countries trading in both live hogs and pigs, and since the trade is unidirectional with animals moving from Canada to the U.S., by construction imports must equal exports. Therefore imports and exports are interchangeable, leaving the need for only two equations, the price equation and either the import demand or export supply equation. Since the focus of this paper is the structural effects of MCOOL on U.S. imports, the import demand equation (equation 1), is estimated simultaneously with the U.S. price equation (equation 3). In equations 1 and equation 3, P^{US} and M are considered to be endogenous whereas all other variables are considered to be exogenous.

The model uses three-stage least square (3SLS) to estimate the structural coefficients of equations 1 and 3. The 3SLS model is used because of the assumptions surrounding the variance covariance matrix that corrects for auto-correlation within the variables (Wachenheim, Mattson and Koo 2004). By correcting for auto-correlation it assures that the estimators are efficient. Correcting for auto-correlation is important in this case to ensure that the error terms of the equation are not correlated over time.

It is also assumed that the elasticities are consistent over the test period; therefore the model is estimated in double log form. The final estimated equations are as follows:

4. $lnM_t = \alpha_0 + \alpha_1 \ln P_t^{US} + \alpha_2 lnRER_t - \alpha_3 lnUSINV_t + \alpha_4 BSE - \alpha_5 K + \alpha_6 lnY_t + \alpha_7 lnM_{t-1} + \alpha_8 D_t + \varepsilon_t$

5. $lnP_t^{US} = \beta_0 - \beta_1 lnM_t + \beta_2 lnP_t^D - \beta_3 lnUSINV_t \pm \beta_4 BSE \pm \beta_5 K + \beta_6 lnP_{t-1}^{US} + \beta_7 D_t + \beta_8 T_t + \varepsilon_t$

The data for this study were gathered from four main sources: Livestock Marketing Information Center (LIMC), the Economics Research Service (ERS), USDA, the Bureau of Economic Analysis and the Bureau of Labor Statistics. The study uses monthly data spanning

the period of January 2000 to January 2011. If the data were not available monthly they were converted to monthly by either simple summation or monthly smoothing.   In the case of the live hog model, the amount of imports is measured in head and was found on the LMIC website (Livestock Marketing Information Center 2011e). These import data were weekly and were transformed into monthly by simple summation. The hog price is the monthly average of the Iowa and South Minnesota cash price and was also found on the LIMC website (Livestock Marketing Information Center 2011a).

The real exchange rate was obtained from the ERS website (Economic Research Service of the United States Department of Agriculture 2011). In the import demand equation the inventory is the entire U.S. swine population in thousands of head (Livestock Marketing Information Center 2011d). These data were only available in quarterly series and were transformed to monthly data by taking the difference between two quarters and dividing that total by three; one third of the difference, whether positive or negative, was then assigned to each month within a quarter excluding the first month. This manipulation assumes that the hog population either increases or decreases uniformly within a quarter.

In the live hog trade equation, the inventory variable is lagged six months to represent the biological time line of the animal. If the total hog population is low one month, it is expected that six months into the future imports will increase to make up for a slaughter animal shortages. The quarterly inventory numbers were found on the LIMC website. Finally, the income variable is represented by the total US personal income measured in billions of dollars and was found on Bureau of Economic Analysis website (Bureau of Economic Analysis 2011).

In the live hog price equation, complimentary pricing is represented by the nearby futures price and was found on the LMIC website (Livestock Marketing Information Center 2011b). The supply variable in the same equation is the federal inspected hog slaughter and is measured in head slaughtered per month. This inventory number was collected from the LMIC website (Livestock Marketing Information Center 2011c).

In the feeder pig import demand equation the amount of imports were also found on the LIMC website and were measured in head (Livestock Marketing Information Center 2011e). The data were summed from weekly to monthly. The feeder pig price is the monthly average of the Total Composite National Direct Pig Price found on the LMIC website (Livestock Marketing Information Center. 2011f). Both the real exchange rate and real income variables are the same as in the live hog model. The supply variable in the import demand equation for feeder pigs is represented by the total pig crop in a given month measured in head and was found on the LIMC website (Livestock Marketing Information Center. 2011d).

In the feeder pig price equation the complimentary price is the hog price, due to the derived demand relationship, and is the same as the price in the live hog price system. The supply number is again the pig crop for any given month, however in this equation pig crop is lagged four periods to represent the time it takes to prepare a pig for finishing.

Both the live hog price and the feeder pig price were adjusted from nominal price to real price using the pork consumer price index found on the Bureau of Labor Statistics website (Bureau of Labor Statistics 2011). All the summary statistics of the variables in non-log form are found Table 4.

Table 4: Variable Summary Statistics

Variable	Mean	SD	Min	Max
US Live Hog Imports	184,197.1	69,270.95	75,613	393,168
US Feeder Pig Imports	416,148.6	121,013	166,666	718,813
US Live Hog Price	36.36	5.36	24.60	47.09
US Feeder Hog Price	19.75	2.91	10.61	26.33
Real Exchange Rate	1.27	0.18	1.00	1.59
Nearby Futures Price	63.21	9.55	35.67	85.13
Total US Pig Population (In thousands of head)	62,216.1	3,116.27	57,546	68,196
US Monthly Hog Slaughter	8,681,702	753,776.1	7,107,600	10,653,500
Pig Crop	8,891,881	525,812	7,803,000	9,993,000
Disposable Income	9,313.13	710.93	8,019	10,441.6

All data is monthly for the year January 2000 to January or 2011. The number of observations is 133.

Datasets for both the live hog model and the feeder pig model were constructed using data found from the aforementioned sources. Using the 3SLS function in the SAS mathematical programs the systems of simultaneous equations was solved for both the live hog and feeder pig models. The results of these two models can be found in the following chapter.

CHAPTER IV

RESULTS

Equations 4 and 5 were solved simultaneously using 3SLS estimation for both the live hog and feeder pig markets. The results of the U.S. import demand function for both the live hog and feeder pig markets can be found in Table 5. The results of the U.S. price equation for both the live hog and feeder pig markets can be found in the table on page 43. The estimates are done in the double log form which results in elasticities for all variables. The system-weighted R^2 for the live hog equations is .91, and .84 for the feeder pig equations, which would suggest that the models are of good fit. All the coefficients in the equations that were significant and had the expected sign expect for exchange rates in the live hog trade system.

Table 5: Results for U.S. Import Demand Equations (P Values in Parentheses)

Variables	Live Hogs	Feeder Pigs
Intercept	65.63 (.0001) ***	-7.901 (0.4315)
US Price	-0.207 (.1000)*	-0.495 (.0648)*
Real Exchange Rates	-1.276 (.0001) ***	0.261 (0.340)
US Inventories	-3.112 (.0001) ***	-1.220 (.0641)*
US income		4.362 (.0001) ***
Lagged Dependent Variable	0.277 (.0018) ***	0.138 (.0897)*
BSE	0.096 (.084)*	0.1329 (.0040) ***
MCOOL	-0.475 (.0001) ***	-0.277 (.0001) ***
System-Weighted R-Square	.9076	0.8427

Notes: there was no seasonality found in either the US import demand equation for live hogs or feeder pigs and was not included in the table. ***indicates statistically significant at the 1% level, **indicates statistically significant at the 5% level, and *indicates statistically significant at 10% level. BSE is the Bovine Spongiform Encephalopathy disease in cattle. MCOOL is Mandatory Country of Origin Labeling.

In the import demand equation the U.S. price, which substitutes for the world price, is inelastic and negative. Even though Canadian hogs represent a small portion of the U.S. slaughter, these imports are significant for plants in northern states that are dependent on Canadian animals to meet their kill quotas. Since it would be difficult and expensive for these plants to source animals from farther regions in the United States or other countries, it would be expected that certain U.S. slaughter houses would continue to buy from Canadian producers unless there were significant price changes. Unless there is a major price change slaughter houses will continue to demand live hogs, and since the U.S. price is the world price, there is no incentive to switch between imports and domestic products.

The only variable that did not follow conventional economic theory was the Real Exchange rate in the live hog import demand equation. It was expected that this variable would possess a positive sign. Conventional economic theory states that as the U.S. dollar appreciates compared to the Canadian dollar, it would be expected that U.S. importers would demand more live hogs, everything else held constant. The model however shows the opposite occurring. As the U.S. dollar depreciates, U.S. importers are demanding more animals. Where conventional economic theory would predict that this relationship is wrong, there is some literature which has found that some products are in higher demand as the import country exchange rate depreciates.

Adams, McCarl and Homayoufarrokh found that in soft wood lumber the effects of an exchange rate movement depended not only on the shift in the exchange rate, but the shift in production costs as well. The authors theorize that in a competitive market for a commodity, exchange rate movements are favorable if the growth in the exporter's costs relative to the

growth of the importer's costs were less than the change in exchange rates (Adams, McCarl and

Homayoufarrokh 1986).

A similar situation could be occurring in the live hog trade. The demand for live hogs is

a derived demand; there is no need to import hogs if there is no demand for pork. Hog imports

are used in the production of pork. The United States and Canada are both net exporters of

pork and compete for world market share. In 2002, the Canadian dollar appreciated, not only

against the U.S. dollar, but against most every foreign currency. In fact, the exchange rate of

both the U.S. dollar and the Canadian dollar, as compared to the currencies of the major pork

importers including Japan, Hong Kong, Russia, China and South Korea has started to converge.

The U.S. dollar continues to weaken against these currencies as the Canadian dollar

appreciates. This convergence of exchange rates means that Canadian pork exports become

more expensive compared to competing U.S. exports. The result is an increase in demand for

U.S. pork products and a decrease in demand for Canadian pork products.

These changes in demand tighten Canadian packer margins and widen U.S. packer

margins thereby creating incentives for U.S. packers who produce product for export to

increase production and demand more inputs. Therefore as the U.S. dollar weakens, U.S.

packers export more pork, and import more hogs from Canada to fulfill the demand for more

pork (Southard 2003a).

The model also found that inventories of the total U.S. swine population were highly

elastic with respect to U.S. import demand. This result would suggest that when the number of

slaughter ready hogs is low in the United States, U.S. packers react by purchasing Canadian

hogs. This purchasing of Canadian hogs maintains full capacity in U.S. packing plants. The

inventory variable in the live hog import demand equation is represented by the entire U.S.

animal population, both pigs and hogs, lagged six months to represent the biological time line of the animal. When U.S. herd numbers are low six months in the past, packers who would normally not purchase Canadian live hogs began to do so as the shortage in live hogs in the local area forces packers to source animals from farther away.

In the live hog import demand models, both the dummy variables representing structural changes to the market were significant and had the expected signs. These results suggest that both these events did have a significant and predictable impact on the live hog trade. The BSE variable has a positive coefficient of 0.096 which would suggest that the closure of the border to live Canadian cattle had a cross market effect which raised the import demand for hogs by approximately 10 percent. This percentage was found by converting the coefficient from natural log to a real number and subtracting by one. U.S. packers did indeed respond to increased demand for pork caused by the increase in the price of beef by importing more live hogs from Canada.

The MCOOL variable has a negative coefficient of -0.475 which would suggest that the implementation of these new countries of origin labeling rules has caused U.S. demand for Canadian live hogs to drop by approximately 38 percent. Many packing firms have stated that they would no longer accept hogs of Canadian origin because of the restrictions associated with the MCOOL legislation. It would appear that enough firms have decided to not accept hogs of Canadian origin to significantly lower trade between Canada and the United States.

It was found that U.S. income had no statistically significant effect on U.S. import demand of live slaughter hogs. There also seems to be no seasonality in the demand for Canadian animals. The lagged dependent variable was found to be significant and of the expected sign. This result signifies that the U.S. is likely to continue to imports live hogs from

Canada if the U.S. has done so in the past. The coefficient associated with this lagged

dependent variable is rather inelastic which would suggest that it takes major shifts in trade in

the past to greatly affect future trade numbers.

U.S. price was found to be both significant and inelastic in the feeder pig import

demand equation. The same explanation for the inelasticity nature of the U.S. live hog price

also applies to the price of feeder pigs in its respective import demand equation. A number of

finishers in northern states depend on Canadian feeder pigs, as there are not enough feeder

pigs to consume all the feed produced in these areas. Since it could be expensive to transport

feeder pigs from other parts of the U.S., there is little incentive to switch away from Canadian

product when there is a price change.

Unexpectedly, it was found that exchange rates had no statistically significant effect on

the trade in feeder pigs. This result could be a reflection of the importance of the Canadian

supply of feeder pigs in a highly integrated North American hog market. It would appear that

the value of the exchange rate over this period of estimation had no significant impacts on U.S.

demand for Canadian pigs. This is somewhat surprising considering the large change in the

value of both the Canadian and U.S. dollar over the past decade. Even though the Canadian

dollar has appreciated, making Canadian feeder pigs more expensive, U.S. finishers still demand

the same number of feeder pigs.

It is also important to note that feeder pig exports from Canada do not react to

exchange rates in the same way as do hogs. It is hypothesized that slaughter plants can make

decisions concerning changes in supply and demand conditions more quickly than finishers. If

finishers want to supply more animals, they must make this decision well in advance of the

expected sale of the finish product. As has been mentioned, it takes some time to fatten an

animal to slaughter weight. This means hog finishers cannot react instantaneously to changes in demand. Processing plants, however, assuming that there is an available supply of slaughter ready hogs can react quickly to changes in pork demand. If demand increases, it does not take much time for plants to increase their kill. Therefore, if demand for U.S. pork products increases because of changes in exchange rates, it is plants that have the capacity to react, not hog finishers and pig producers. The biological time line of producing hogs constrains the ability of pig producer to respond to changes in the short run.

The income variable in the feeder pig trade equation was found to be of expected sign and highly elastic. The coefficient was found to have an elasticity of 4.2 and represents changes in the total U.S. disposable income over the estimation period. As income in the United States increases, so does the amount of feeder pigs imported. The high elasticity of this variable might suggest that the feeder pig trade is highly sensitive to growth and recessionary patterns in the United-States, more so than live hogs. This effect could be explained by the demand and costs of producing both live hogs and feeder pigs. Even though demand for pork may be affected by growth patterns in the United States, consumer demand is not higher for animal protein, but rather other consumer goods. The opposite occurs in times of recessions. As incomes fall, U.S. consumers do not replace high protein food stuffs with less expensive substitutes but rather cut out big ticket items from the budget and discretionary spending. Hence demand for pork, while affected by growth trends, remains relatively stable during periods of economic growth, whereas recession may force feeder operations to shut down or reduce production. This loss of production at the feeder level would cause a decline in the number of imported feeder pigs. The relatively stable production of pork would suggest that slaughter hog import demand would remain unchanged.

The inventory variable was also found to be of the proper sign and significant. As was predicted, as the number of pig births in the United States goes up, the number of feeder pigs imported from Canada decreases. The variable associated with the pig crop was also found to be elastic with a coefficient of –0.98. This result suggests that a lot finisher base their import decisions on the number of births. If the birth rate is relatively high, importers, especially those far away from the border, will demand fewer Canadian animals because there is plenty of local supply. If the birth rate of pigs is low in the United States, then Canadian animals fill in for the domestic deficit. The lagged dependent variable was also found to be positive and significant.

Both the dummy variables for the events surrounding BSE and the final implementation of MCOOL were found to be significant and of the expected signs. During the months associated with the border closure to live cattle imports, the import of feeder pigs grew by approximately 14 percent, everything else held constant. The closure of the border to Canadian live cattle exports was not a short affair. The U.S. border remained closed to some form of Canadian live cattle exports for a period of 55 months, approximately four and a half years. Again, this border closure caused the price of beef to rise because of a shortage of slaughter cattle that would have been supplied by Canadian producers. These higher prices for beef products caused a cross product effect which resulted in higher demand for pork, a substitute for beef.

Even though there is a biological time line associated with the production of feeder pigs into slaughter hogs, the prolonged border closure provided enough time for finishers to participate in this increase in demand. If the border was closed for only a short period of time, it could be hypothesized that the increase in demand for pork would have been short lived and hence only slaughter plants would be flexible enough to take advantage of the shift in demand.

However, since the border was closed for such an extended period of time, finishers had the opportunity to import and feed out feeder pig imports from Canada before the U.S. beef market could stabilize after the BSE market shock.

The implementation of the MCOOL rules has decreased the import demand for Canadian feeder pigs by 24 percent. It is hypothesized that a number of finishers found the costs of tracking and maintaining origin records prohibitive and as such stopped importing Canadian feeder pigs. It has also been noted earlier that some slaughter plants have decided that the cost of segregation associated with the regulations of MCOOL is prohibitive and as such will no longer accept Canadian hogs. For finishers that provide slaughter hogs to these plants, the relative cost of implementing the MCOOL regulations are of no concern. If a slaughter house will not accept Canadian animals, finishers that supply that slaughter facility have no incentive to purchase and finish Canadian animals. In these particular cases, the once homogeneous product has become differentiated and the demand for Canadian product is zero. It would seem that enough finishing firms fit into these two categories to reduce total trade in feeder pigs by nearly a quarter.

Table 6: Results for U.S. Price Equations (P Values in Parentheses)

Variables	Live Hogs	Feeder Pigs
Intercept	0.915 (.0901) *	19.512 (.0026) ***
Imports into the U.S.	-0.028 (.2284)	-0.217 (.0450) **
Complementary Price	1.012 (.0001) ***	0.284 (.0001) ***
US Supply	-0.108 (.0242) **	-1.053 (.0028) ***
Lagged Dependent Variable	0.049 (.0066) ***	0.689 (.0001) ***
BSE	0.027 (.0296) **	-0.027 (.1853)
MCOOL	0.35 (.7260)	-0.050 (.1576)
January		-0.061 (.0344) **
February		-0.121 (.0001) ***
March		-0.204 (.0001) ***
April		-0.030 (.0001) ***
May		-0.240 (.0001) ***
June		-0.285 (.0001) ***
July		-0.233 (.0001) ***
August		-0.247 (.0001) ***
September		-0.175 (.0001) ***
October		-0.086 (.0057) ***
November		-0.028 (0.315)***
Trend		0.003 (.0069) ***

Notes: ***indicates statistically significant at the 1% level, **indicates statistically significant at the 5% level, and *indicates statistically significant at 10% level. BSE is the Bovine Spongiform Encephalopathy disease in cattle. MCOOL is Mandatory Country of Origin Labeling.

The results for both the live hog and feeder pig U.S. price equations can be found in

Table 6. When looking at the price equation for the live hog system, it was found that the

number of hogs imported into the U.S. market had no effect on price. At any given time,

Canadian imports of both live hogs and feeder pigs only accounts for 6 percent of the U.S.

slaughter. In some local areas, Canadian imports of slaughter animals are very important.

However, in the entire U.S. market, the amount of Canadian live hog imports is relatively small

and will not have the ability to change price. This finding is not in line with findings found by

Wachenheim et al. but does reflect the shift in importance away from slaughter ready live hogs

in favor of feeder pigs over the last decade.

The futures market price in the live hog price equation, which acts like a complementary price, was found to be almost unitary elastic to the hog price. If the nearby futures price for hogs increases by one dollar, the actual price for hogs will increase by one dollar. The US supply variable, represented by the federally inspected national slaughter, was found to be significant and of the expected sign, as supplies increase the price decreases. This coefficient however was found to be very inelastic which represents the biological time line required to produce hogs, because it takes time for changes in production decisions to take effect.

The events surrounding BSE had only a small impact on the price of live hogs in the United States.   The increase in demand caused by the cross product affect associated with the increase in beef prices caused the price of live hogs to increase by 2.8 percent.   The MCOOL variable was found to be insignificant suggesting that whether or not consumers are actually willing to pay a premium for origin information, these premiums are not being transmitted to finishers.   It would also appear that finishers are having difficulties passing any increase in costs associated with the implementation of the MCOOL regulations to slaughter plants. The failure to pass on any price change may be due to weak margins. Packers may be willing to absorb costs to maintain plant capacities. According to the results of previous studies, the implementation of MCOOL has imposed new costs on finishers without producing any changes in pricing. The model found that there was no seasonality or trend in the pricing of live hogs.

The number of imports of feeder pigs from Canada did have an effect on the U.S. price for feeder pigs. The coefficient was found to be both negative, as theory would predict, and inelastic. Over the last decade, the majority of live trade between the United-States and Canada has shifted from slaughter hogs to feeder pigs.   Where Canadian exports of live hogs

do not make up a large amount of the U.S. slaughter, Canadian exports of feeder pigs do make up a significant proportion of the feeder pig market. On average, over the past decade, 4.5 percent of feeder pigs fed in the U.S. are of Canadian origin. This proportion at one point reached a high of 7.6 percent.   Even though this is a small percentage, it is large enough to affect price, especially in areas that are highly dependent on Canadian imports. The coefficient associated feeder pig import variable is however found to be rather small with an elasticity of only -0.217. This inelastic coefficient would suggest that even though the U.S. price for feeder pigs is affected by imports from Canada, the effect is rather small and it takes a large shift in the number of head exported into the United States to change prices.

The complement price, represented by the U.S. live hog price because of the derived demand relationship, was found to be significant and of the proper sign, but inelastic. This result would suggest that prices for feeder pigs are rather fixed in relation to the live hog price. The supply coefficient was found to be negative as theory would suggest. The elasticity of this variable is approximately -1, leading to the conclusion that even though the price of feeder pigs does follow a biological time line like live hogs, the price of feeder pigs is more responsive to changes in supply as compared to live hogs.   Because the biological time line of the animal is shorter in feeder pigs, as compared to live hogs, it would be expected that the elasticity will be greater for feeder pigs. Producers of feeder pigs can react faster to market changes as compared hog finishers because the time line of the animals is only 3 to 4 months.   The lagged dependent variable was found to be positive and significant. It was also found that there is significant seasonality in the pricing of feeder pigs and there has been a very slight permanent upwards trend in the price of feeder pigs over the entire decade.

Both the dummy variable representing the events of BSE and the implementation of MCOOL regulations were found to be insignificant. As with the price of hogs, it would appear that regardless of a willingness to pay by consumers for the country of origin information, any price increase in pork associated with MCOOL is not being passed through the supply chain to pig producers. Also, hog breeders are not able to pass on any extra costs associated with MCOOL up the supply chain to hog finishers. Like in the live hog market, according to past literature the implementation of MCOOL has increased costs without changing prices. In the case of BSE, even though finishers could take advantage of the higher demand and receive higher prices, pig producers did not see an increase in price.

CHAPTER V

CONCLUSION

Over the past two decades, the North American pork industry has evolved into an integrated market. This integrated market does not only involve the trade in pork products, but also live pigs and hogs between the United States and Canada. Because of trade liberalization structural changes to hog production during the 1990s, live hog and feeder pig trade between Canada and the United States increased, with the two markets behaving as one integrated market place. As swine operation trended towards consolidation and specialization, and producers began looking for areas far from population centers to expand, Canada became very attractive for industry growth. There however have been some events over the past decade that has disrupted this trend. Three primary conclusions of this thesis are discussed in this chapter.

In 2002, the United States congress passed legislation that could alter and hinder this integrated market that has formed over the last decade, this legislation being MCOOL. The results of this study produce evidence that MCOOL regulations have indeed decreased trade by acting as a non-tariff barrier to trade, as many packers in the United States have decided not to accept Canadian slaughter hogs because of segregation and tracking costs that became necessary under the new regulations. Since packers may no longer accept hogs of Canadian origin, finishers who would normally source Canadian feeder pigs will no longer demand feeder pigs from Canada as demand for these animals was reduced. Results of this study indicate that

the implementation of MCOOL decreased the monthly trade in live hogs and feeder pigs by 37.8 percent 24.1 percent respectively.

This study also found that the U.S. border closure attributed to BSE had a cross product effect. Like the swine industry, Canadian exports of live cattle to the United States represent a sizeable part of U.S. slaughter. When the border closed, a shortage in slaughter steers caused the price of beef to increase which in turn increased demand for pork, a substitute for beef. Since the border was closed for almost 55 months, both packers and finishers in the hog industry were able to take advantage of the increase in demand for pork. The border closure caused the trade in both live hogs and feeder pigs to increase by 10 percent and 14 percent respectively.

Finally, the exchange rate between the U.S. and Canadian dollar has had a significant impact on trade. Results indicate that the U.S. Canadian exchange rate has no effect on the U.S. demand for feeder pigs. It would appear that the feeder pig market in Canada and the United States has become so integrated that exchange rates have little effect on import decisions made by hog finishers. It was also found that as the U.S. dollar depreciates, U.S. packing firms demand more Canadian hogs for slaughter. Even though this might seem counter intuitive it is hypothesized that as the U.S. dollar depreciates major pork importing countries begin to demand more U.S. pork products. The low U.S. dollar makes U.S. pork products less expensive compared to other pork exporting countries such as Canada. Even though Canadian hogs have become more expensive over the last decade because of a depreciating U.S. dollar and an appreciating Canadian dollar, U.S. packers demand more slaughter hogs to meet growing demand for U.S. pork in the rest of the world.

The U.S. Canadian border re-opened to the trade in live cattle at the end of 2007 and as such the market has had time to re-adjust, however industries both in the United States and Canada will have to adapt to a market containing the regulations of MCOOL. The decreased trade flows caused by MCOOL will produce an excess of both feeder pig and slaughter hog supply in Canada. There are differing opinions as to whether or not Canada has the slaughter capacity to accommodate this excess supply. If Canada can increase its slaughter then a shift in exports is to be expected whereby more pork products already labeled product of Canada will be exported to the United States. This shift might be difficult to achieve due to Canada's strict labor laws. Also, if the Canadian dollar continues to strengthen against the U.S. dollar, Canadian exporters of pork might lose market share to other exporting countries. The United States might face shortages of both live hogs and feeder pigs as Canadian import supply chains are disrupted by the MCOOL regulations and packers source only U.S. products. The United States could reduce its global market share to meet domestic demand, a market share that could be filled by Canadian pork products.

It has also been suggested that Canadian feeder pigs and live hogs will continue to flow into the United States after a period of adjustment, as the pork product from imported animals finds its way into the HRI and trade sectors, which are exempt from MCOOL. The option of using Canadian feeder pigs and slaughter hogs only for these sectors still has segregation costs and limits slaughter plants customer base.

In the long run, the pork industry in both the United States and Canada will have to adjust to accommodate new realities produced by the implementation of MCOOL.   If U.S. firms continue to reject Canadian feeder pigs and live hogs, producers will face significant downward pressure on price as supplies in Canada increase. There are two possible reactions to such an

increase in supply, either an increase in both the Canadian feeding and slaughtering capacity, or a reduction in supply created by producers leaving the industry. It is too early to tell how the market will react, but some anecdotal evidence already suggests that Canadian slaughter plants have not increased production and that producers are leaving the industry. Further research is required however to substantiate these claims. Canadian processors might however gain from the implementation of MCOOL. The surplus of live hogs and feeder pigs in Canada will mean lower input costs for Canadian packing facilities, while prices at retail level in the short run remain constant as demand for Canadian pork by domestic consumers remain unaltered. This situation of stable price and falling input costs could mean increased margins for Canadian packers. Since the regulations of MCOOL can easily be met by exporting table ready goods to the United States, Canadian packing houses could see an increase in U.S. market share.

In reaction to MCOOL, Canadian policy makers have launched official complaints at the WTO. These proceedings however take a long time to come to a conclusion and even with a positive result for Canadian there is no guarantee that the MCOOL program will be terminated. In many of cases involving the WTO, market conditions have already adjusted long before any official ruling. There have been some calls for an increase in slaughter capacity in Canada by building more slaughter facilities. Recent history in relation to the BSE crises however has shown that there is little market support for such an expansion. After the crises began there were many calls for an expansion of slaughter capacity in the cattle industry which never materialized. Unlike the BSE crises which at some point was always thought to come to an end, it is unlikely that the MCOOL program will be terminated anytime soon. It might therefore be time for policy makers in Canada to start examining ways to expand the Canadian slaughter capacity.

It was found that Canadian imports had little effect on the price of feeder pigs and no effect on the price of slaughter hogs. As such it is unlikely that producers will see any significant increase in price associated with a lack of supply in the U.S. Slaughter houses will now have to source more U.S. origin animals to fill their kill quotas. It would be expected that costs for these slaughter houses will increase as firms must source input animals from further and further away. In some areas it will be difficult to increase production of live hogs and feeder pigs as environmental and location issues remain a concern. If the United States finds that it must significantly increase production to make up for short falls in supply from Canada, policy makers must decide whether or not to allow expansion in pre-existing hog producing regions. If policy makers decide that existing hog producing locations are already saturated, the expansion of hog production will be pushed west where there are increased costs of delivering feed and quality concerns as the animals do not fare well in the southern climates. One of the reasons for the expansion of hog production in Canada was the resolution of these environmental and location concerns. The forced costs associated with MCOOL of constructing a segregated system for Canadian born animals could negate this Canadian comparative advantage.

Where this study has found evidence that the implementation of MCOOL has decreased trade in both feeder pigs and live hogs from Canadian there is still much research to be done. This study has considered the United States as a whole. There are areas in the United States that are far more dependent on both Canadian live hogs and feeder pigs. To truly know the economic impact of the MCOOL regulations on regions and states requires an analysis of these areas separate from the rest of the United States.   The current model found evidence that MCOOL has not altered the price for both live hogs and feeder pigs. It would be of interest

to find whether the implementation of MCOOL has affected the price of pork and whether

consumers are willing to pay a premium for origin labeling information.

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