Country of Origin Labeling: Evaluating the Impacts on U.S. and World Markets

Keithly G. Jones, Agapi Somwaru, and James B. Whitaker

A provision of the Food, Conservation, and Energy Act of 2008 requires country of origin labeling (COOL) for certain agricultural commodities. To comply with the law, producers, processors, and retailers face additional production costs associated with labeling, separating, and tracking commodities. Using estimated costs provided by the U.S. Department of Agriculture's Agricultural Marketing Service (AMS), we simulate the impacts of mandatory COOL on U.S. and global agricultural markets using a global static general equilibrium model (STAGEM). The results show resource adjustments that lead to decreases in production, consumption, and trade flows. The results assume no demand premium for labeled commodities relative to unlabeled commodities.

Key Words: country of origin labeling, agricultural trade, global general equilibrium

A provision in the Farm Security and Rural Investment Act of 2002 (2002 Farm Act) required certain commodities—beef, pork, lamb, fish and shellfish, fruits and vegetables, and peanuts—sold at the retail level to be identified by their country of origin label (COOL). In a 2004 ruling, regulations were published to implement COOL for fish and shellfish. The regulations became effective in April 2005. Congress responded to growing criticisms of the program by extending the comment period and allowing further debate on the COOL provision for the remaining commodities. This resulted in a delay of mandatory COOL for the remaining covered commodities.

The Food, Conservation, and Energy Act of 2008 (2008 Farm Act) amended the COOL provisions. Goat meat, poultry, macadamia nuts, ginseng, and pecans were added as commodities covered by mandatory COOL. Regulations for all covered commodities were published in August 2008, and COOL provisions were implemented on September 30, 2008. The U.S. Department of Agriculture's Agricultural Marketing Service (USDA-AMS) issued a final ruling for COOL on January 15, 2009 (Federal Register 2009). It became effective on March 16, 2009.

COOL increases the cost of production for covered commodities through increased labeling, separating, and tracking costs. This affects production along the entire supply chain, including imported commodities. Cost increases are likely to lead to decreases in the production of covered commodities, both domestic and imported, and to higher commodity prices. Cost estimates for implementing COOL in the impacted sectors of the supply chain are provided by the AMS (see Federal Register 2008).

We use a global static general equilibrium model (STAGEM) to evaluate market responses and resource adjustments to mandatory COOL. The STAGEM model reflects world markets as they were in 2004. We employ the widely accepted equivalent variation (EV) method to measure social welfare gains or losses due to mandatory COOL. The EV measurement of welfare uses status quo (pre-policy) prices as a base and addresses the question: What change in income at the current prices would be equal to the change brought about by the policy in terms of the impact on utility? (Varian 1992) Our welfare indicator accounts for producer and consumer welfare, capturing economy-wide resource reallocation and adjustment due to mandatory COOL. However, our results assume no consumer preference for mandatory COOL relative to no labeling system.

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Given the cost assumptions developed by AMS (see Table 1), we find that the mandatory COOL provision reduces overall U.S. welfare through its impacts on commodity and downstream processing markets. We show that the costs of complying with mandatory COOL are likely to lead to decreases in agricultural production and increases in agricultural prices. Global market impacts are also reported, with trade volume and global welfare declining. Again, these results assume no consumer preferences for country of origin labeled commodities.

Given the uncertainty of consumer responses to mandatory COOL, we model only the impacts of increased costs (as provided by AMS) on both consumers and producers due to COOL implementation. Our results represent the changes in welfare, prices, production, and trade with this policy change. If consumers prefer labeled commodities in any degree, then demand shifts induced by COOL could result in changes in prices, quantities, and welfare that differ from the findings in this study in both magnitude and direction.

In the next section we discuss the relevant literature and qualify our assumption of excluding potential demand premiums for labeled commodities from our analysis. We then present the main specification of the STAGEM model and discuss how increased costs from mandatory COOL are modeled. A discussion of the results follows, with an additional econometric test of whether fish markets, the only commodity for which mandatory COOL was implemented under the 2002 Farm Act, experienced any structural change with the implementation of mandatory COOL. Finally, we offer some concluding remarks, including areas for future research.

Literature Review

Country of origin labeling has been a topic of political debate for over a decade. Passed as law in the 2002 Farm Act, implementation for most commodities was delayed, allowing for continued debate by those opposed to and those in support of mandatory COOL (Preston and Kim 2008). The source of debate focused on three key issues: trade implications, costs, and benefits.

Opponents argued that mandatory COOL could lead to trade distortion or be interpreted as a nontariff barrier to trade under World Trade Organization (WTO) obligations (Rude, Iqbal, and Brewin 2006). Mandatory COOL may therefore lead trade partners to retaliate or seek redress through litigation at the WTO, impacting the exports (McFadden 2008). This led the majority of representative hog producers at the annual meetings of the National Pork Producers Council to cite trade distortion as a main reason they did not sup-

Table 1. Estimated Increases in Operating Costs by Supply Chain Segment and Industry

		Percent Change				
		Beef, Lamb, & Goat	*Pork*	*Chicken*	*Fish*	*Fresh Produce*
Farm Supply	*Domestic*	1.30	1.30	0.00	0.60	0.10
	Imported	1.30	1.30	1.00	0.60	0.10
Processing	*Domestic*	2.10	1.00	1.10	n.a.	n.a.
	Imported	2.10	1.00	1.10	n.a.	n.a.
Retail	*Domestic*	2.20	0.40	0.60	0.40	0.60
	Imported	2.20	0.40	0.60	0.40	0.60

Note: All values represent a percentage change in the cost of production for the sector and supply chain entity. N.A. means not applicable. Our cost estimates are taken from the U.S. Department of Agriculture's Agricultural Marketing Service estimates found in the *2008 Federal Register* 73(149): 45106-45151.

port mandatory COOL (Meyer 2008). Schupp and Gillespie (2001) found that fresh and frozen beef handlers listed "government interference in free trade" as a reason for opposing a then potential mandatory COOL provision.

Opponents also argued that the costs of complying with mandatory COOL were too high. Fruit and vegetable producers face high costs for record-keeping and compliance (VanSickle 2008). Beef and pork producers and processors incur costs for tracking and separating live animals of different origins (Peel 2008, Meyer 2008). However, costs vary by region and type of livestock, leading some livestock producers to favor mandatory COOL. In the United States, for example, cattle production in the North is more integrated, with large cattle operations often selling cattle directly to feedlots. In the South, cattle are more often bought and sold several times over before slaughter, making commingling of animals of different origins more likely and tracking more costly. Peel (2008) states that it will be challenging to oversee and enforce mandatory COOL in an industry that remains fairly diffused, especially at the cow-calf stage. Meyer (2008) points out that it will be more difficult and more costly to implement mandatory COOL in the beef and pork industries than in the poultry industry. He contends that the domestic and integrated nature of the poultry industry shelters it from the transition costs and new tracking systems that the beef and pork industries will face.

While estimates for the costs of implementing mandatory COOL are available from the AMS, the potential response of consumers to mandatory COOL is unknown (McFadden 2008). Some studies find evidence of consumer preferences for country of origin labeled commodities, while others argue that the lack of voluntary COOL in the market is evidence that there will be no preference for mandatory country of origin labeled commodities.

Lusk et al. (2006) point out that consumers may prefer labeled commodities if country of origin is strongly correlated with product quality in the minds of consumers or if consumers are ethnocentric, preferring domestically produced goods. Studies do show that COOL is important to consumers, but not as important as other attributes such as genetically modified food content or USDA food safety inspection certification (Loureiro and Umberger 2007, Ehmke, Lusk, and Tyner 2008, Froehlich, Carlberg, and Ward 2009). Loureiro and Umberger (2003, 2005) find that willingness to pay for labeled U.S. meat products is positive and sufficiently high to cover expected COOL implementation costs. VanSickle et al. (2003) also find that the benefits of country of origin labeling of commodities substantially outweigh the costs associated with labeling.

If consumers do prefer labeled commodities and are willing to pay a premium, some suppliers would be expected to respond voluntarily by providing country of origin labels and capturing the premium associated with that willingness to pay. A voluntary COOL system was administered by the U.S. Department of Agriculture's Food Safety and Inspection Service (FSIS) (see Federal Register 2001), but Krissoff et al. (2004) note that little or no voluntary labeling occurred in the market. The lack of voluntary COOL could imply that the demand for labeled commodities is insufficient to cover the costs of labeling. The AMS also takes a position that benefits from mandatory COOL do not exceed the costs (see Federal Register 2009). Therefore, despite some empirical evidence of a consumer preference for labeled commodities, the "revealed preference" of no voluntary COOL makes it unclear how consumers are likely to respond to mandatory COOL.

Model and Data

The STAGEM model used in this study is based on neoclassical growth theory with a multi-region and multi-sector specification (for more details, see Diao and Somwaru 2000 and 2001, Diao, Somwaru, and Roe 2001, and Roe, Somwaru, and Diao 2006). In each region the representative household owns land, labor, and capital and maximizes utility. For the sake of simplicity, we assume no independent government investment. Government spends all its tax revenues on consumption or transfer to households and, hence, fiscal deficit is ignored.

Unlike a partial equilibrium framework that captures a particular subsector of the economy with all other variables being exogenous to the model, the global general equilibrium approach takes into account the entire economic system; it captures not only the direct impact of, say, a policy shock such

as COOL on the relevant subsector, say, agriculture, but also the interaction and linkages between other areas of the economy, along with feedback effects from the upstream and downstream industries on agriculture. One contribution of a global CGE model is its comprehensive look at the impact of policy change on the global economy, taking into account the various linkages among economic entities and allowing simultaneous adjustments in demand and supply forces. In the case of mandatory COOL, the goal is to quantify the impact of country of origin labeling on the U.S. economy and the world economy. The model results capture changes in resource allocation and adjustments in farmer, processor, and retailer production structure due to the implementation of mandatory COOL. Also, the model was able to capture the change in both the United States and global welfare as a result of the policy. The outcomes can be viewed as medium-term impacts.

Sectors and commodities directly affected by the mandatory COOL provision of the 2008 Farm Act are included in an updated version of the STAGEM developed at the Economic Research Service (ERS) of the U.S. Department of Agriculture. Production and consumption decisions in each region are determined within the model, following behavior that is consistent with economic theory. Multilateral trade flows and prices are determined simultaneously by world market clearing conditions. In other words, prices adjust to ensure that total demand equals total supply for each commodity in the world. All economic sectors—agricultural and nonagricultural—are included, while the model allows resources to move among sectors in response to policy change, thereby ensuring that adjustments in the feed grains and livestock sectors, for example, are consistent with adjustments in processing sectors.

Thus household's utility is:

$$\max u(\ln TC_n) \tag{1}$$

where $u(\ln TC_n)$ is utility while TC_n represents the aggregate consumption of final goods and is defined as:

$$TC_n = \prod_i C_{ni}^{\alpha_{ni}} \tag{2}$$

where C_{ni} is final good i in region n, and

$$\sum_i \alpha_{ni} = 1.$$

The household in each region maximizes equation (1) subject to the following budget constraint:

$$Pc_n TC_n \leq \left[\left(ld_n\right) wld_n + \left(lb_n\right) wlb_n + (k_n) wk_n + TI_n\right] + \varpi_{n0} \tag{3}$$

where Pc_n is a consumer price index such that

$$Pc_n TC_n = \sum_i Pc_{ni} C_{ni}.$$

The variables ld_n, lb_n, and k_n are household land, labor, and capital income, respectively; while, wld_n, wlb_n, wk_n are the returns to those factors of production, or the land rental rate, the wage rate, and the capital rental rate, respectively. TI_n is the lump sum transfer of government revenues and, finally, ϖ_{n0} is the value of the household's fixed financial wealth. Households allocate their total income flows between consumption and savings, while savings are held constant in this static framework.

We assume that the technology exhibits constant returns to scale and that capital and labor, as input factors, are perfectly mobile among sectors. Producers maximize their profits, while competition among firms ensures that, at the equilibrium, marginal costs are equilibrated with the value of the marginal products of each industry.

The traditional Armington functions are all specified. For consumers, goods imported from abroad or produced domestically are not identical. This imperfect substitution between domestic and imported goods is reflected with an Armington constant elasticity of substitution (CES) function. To simplify the analysis, we assume that composite goods used for consumption are also used as intermediate inputs in each production sector, a main characteristic of a static CGE model.

The ERS CGE model uses data from the Global Trade Analysis Project (GTAP database, version 7.2). The GTAP database includes 57 commodities and 101 country/regions. For this analysis, regions are represented by the following country/regions: the United States, Canada, Mexico, the European Union-25 (EU), Oceania, China, Other East Asian Countries, India, Other South Asian Countries,

Brazil, South America (including Central America), OPEC Countries, Russia, Africa, and the Rest of the World. The agricultural sector is subdivided into the following 12 commodity aggregations: rice, wheat, corn, other feed grains (barley, sorghum), soybeans, sugar (cane and beets), vegetables and fresh fruits, other crops (cotton, peanuts), cattle and sheep, hogs and goats, poultry, and fish. The food processing sectors are sub-divided into the following seven commodity aggregations: bovine cattle and sheep meat, pork meat, chicken meat, vegetable oils and fats, other processed food products, beverages and tobacco, and fish. The remaining sectors in the database were represented by 18 aggregated nonagricultural sectors.

How Costs of Implementing COOL Are Modeled

To comply with the COOL provision of the 2008 Farm Act, retailers incur the costs of labeling, separating, and tracking covered commodities. Other economic agents along the supply chain—farmers and ranchers, processors and slaughterhouses, and importers—also incur additional costs in maintaining records and providing retailers with the necessary country of origin information. Upon inspection, this trail of records must be made available to be in compliance with the COOL provision of the 2008 Farm Act.

The AMS developed cost estimates for implementing mandatory COOL that provide the basic policy scenario for the analysis (Federal Register 2008). Table 1 shows the AMS assumed percentage changes in costs experienced in each covered commodity sector along different segments of the supply chain. Note that different parts of the supply chain in the same commodity sector face different costs for their roles in complying with the COOL provision of the 2008 Farm Act. For example, AMS assumes beef retailers incur a 7 cents implementation cost per pound of beef. This cost covers labels, record keeping, labor, and other costs associated with COOL compliance. Cattle slaughterhouses, on the other hand, are assumed to incur a cost of 1.5 cents per pound of beef, covering the cost of tracking cattle from different countries of origin during the slaughter process. All of the cost assumptions for each sector and level of the supply chain can be found in the *Federal Register,* Volume 73, number 149, Aug 1, 2008. We model the AMS developed costs as a shock on the supply chain while the model endogenously provides estimates of welfare changes.

Results

Our results were able to show that the policy shock associated with COOL directly affects the domestic agriculture and ag-related sectors in addition to its effects on global agricultural trade. Both consumer and producer welfare for the United States and globally were also affected. Not surprising was the negative effect that the increased production cost associated with COOL would have on domestic production and exports of the covered commodities. Increased prices associated with COOL would result in decreased production and trade and would lead to net welfare losses for both the U.S. and global economies. Table 2 shows that for all agriculture and ag-related sectors, prices increased and production and export decreased.

However, imports showed mixed results. Perishable commodities (fruits and vegetables) and fish both experience small, but positive increases in imports. This suggests that the increased operating costs at the farm level for fish and fresh produce would result in a reduction in supply and a subsequent need for more imported fish and fresh produce. Interestingly, live cattle and hog imports

Table 2. CGE Analysis: Estimated Impacts of COOL on U.S. Production, Prices, and Trade Flows

	Percent change from base year (2004)			
	Price	**Production**	**Exports**	**Imports**
Fruit and Vegetables	0.21	-0.20	-0.39	0.04
Cattle, Sheep & Goats	0.52	-0.94	-1.18	0.25
Broilers	0.03	-0.56	-0.36	-0.03
Hogs	0.26	-0.46	-0.60	0.16
Beef, Lamb & Goat	0.99	-1.09	-1.93	-2.32
Chicken Meat	0.82	-0.90	-1.54	0.29
Pork	0.68	-0.81	-1.37	-0.86
Fish	0.50	-0.68	-0.06	0.04

Source: ERS model estimates

increased, while processed products imported from these animals decreased. This is probably due to the fact that the increase in production costs of domestic live animals reduces the supply of domestic animals available for market and, in order for processing plants to continue to operate at full capacity, more live animals would have to be imported. Overall cost increases are expected to translate into higher prices that would reduce the demand for beef and pork, thereby reducing the amount of processed products imported. This may appear counterfactual to the existing short-run disequilibrium situation, but we reiterate that our outcomes can be viewed as medium-term equilibrium impacts when all factors have fully adjusted.

Table 3 displays the percentage change in imports by value of production as well as the dollar change (in millions) in value of production. Beef and pork imports decline by $32 million and $15 million, respectively, while live cattle and hog imports increase by $8 million and $3.5 million, respectively. The opposite holds for the poultry sector; live broiler imports decline while chicken meat imports increase. This is because the largely domestic-oriented poultry industry is heavily shielded from some of the farm level direct cost increases associated with COOL, which cattle and hogs would encounter.

Table 3. CGE Analysis: Estimated Impacts of COOL on Value of U.S. Trade Flows

	U.S. Exports		U.S. Imports	
Product	*Percent Change in Value*	*Dollar Change in Value (millions)*	*Percent Change in Value*	*Dollar Change in Value (millions)*
Fruit and Vegetables	-0.25	-2.46	0.05	0.50
Cattle, Sheep & Goats	-0.78	-4.77	0.37	8.08
Broilers	-0.23	-1.51	-0.42	-1.28
Hogs	-0.39	-2.90	0.18	3.56
Beef, Lamb & Goat	-1.27	-5.53	-2.9	-32.05
Chicken Meat	-1.01	-4.16	0.38	2.94
Pork	-0.89	-2.37	-1.07	-15.28
Fish	-0.04	-0.45	0.05	0.50

Source: ERS model estimates

Table 4. CGE Analysis: U.S. Production, Price, and Trade Impacts of COOL on Agricultural and Ag-Related Sectors

	Percent Change
Price	0.02
Agricultural Production	-0.02
U.S. exports (value)	-0.10
U.S. exports (volume)	-0.17
U.S. imports (value)	-0.12
U.S. imports (volume)	-0.10
Total U.S. welfare loss/gain	**-0.00250**

Source: ERS model estimates

The various trade flow outcomes can be explained by differences in the relative costs of mandatory COOL compliance. Both imports and exports of beef products decline by higher percentages than other commodities because they experience the largest estimated cost increases at the processing and retail levels. Note that in December of 2003, the first case of bovine spongiform encephalopathy (BSE) in the United States was announced and severely impacted U.S. beef export markets. The model base year of 2004 reflects the impacts of the 2003 BSE discovery. Because of the nature of the poultry sector in the United States, domestic chicken producers are assumed to incur no costs for mandatory COOL compliance, while foreign farm-level chicken production does incur costs. This makes foreign broiler production relatively more expensive, leading to a decline in broiler imports. For cattle and hog producers, both domestic and foreign producers at all levels of the supply chain are assumed to face the same percentage cost increases (see Table 1). Note that countries with a comparative cost advantage in the production of COOL exported commodities are likely to react differently than countries that are less competitive in producing COOL commodities.

The increased costs associated with COOL lead to decreases in producer and consumer welfare, not just for covered commodities, but for agriculture as a whole, due to the interlinkages among sectors. Table 4 shows the effects of COOL on U.S. production, prices, trade, and welfare on U.S.

Table 5. CGE Analysis—World Production, Price, and Trade Impacts of COOL on Agricultural and Ag-Related Sectors

	Percent Change
World price	0.009
World agricultural production	-0.039
World trade of ag-related sectors (value)	-0.032
World trade of ag-related sectors (volume)	-0.042
Total Global welfare loss/gain	**-0.0092**

Source: ERS model estimates

agriculture as a whole. Welfare declines in the United States by 0.0025 percent, or by approximately $211.9 million from a 2004 base level. The global economy is also affected by the implementation of mandatory COOL. Foreign producers exporting to the United States face increased production costs for complying with COOL, while foreign consumers also face higher prices due to supply constraints caused by a reduction in U.S. agricultural exports. This translates to a decline in total global welfare as seen in Table 5.

How Has Mandatory 2005 COOL Affected Fish and Shellfish?

Since mandatory COOL for fish and shellfish was enacted on April 4, 2005, it is the only commodity for which an ex post analysis of the effect of COOL is possible at this time. As such, we examine aggregate fish trade for post-COOL structural changes using U.S. fish trade data from the Global Trade Information Services online trade data system. We use a univariate vector autoregressive (VAR) model to estimate both exports and imports using a stationary VAR(2) process specified as[1]

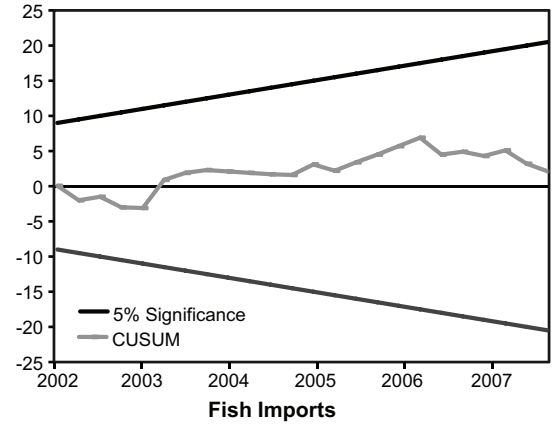
$$(4) \qquad Y_{it} = A_0 + A_1 Y_{it-1} + A_2 Y_{it-2} + \varepsilon_{it}$$

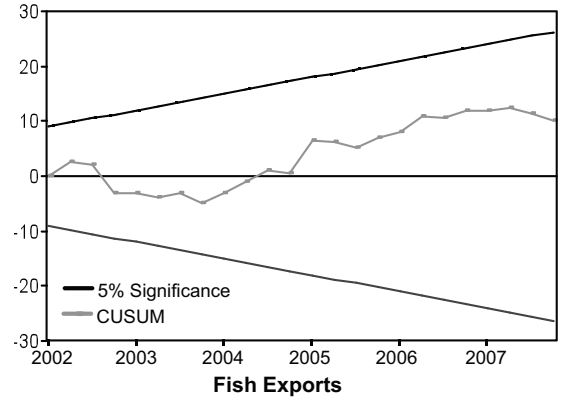
where Y_{it} represents the quantity traded; A_0, A_1, A_2 are unknown parameters; and ε represents the error term. We then use the CUSUM statistic to test for structural change (Brown, Durbin, and Evans 1975). Operating under the hypothesis that the parameter estimates are constant in every time period, the CUSUM test captures potential structural changes (if any) that would cause the parameter estimates to differ across time. Recursive residuals are used to test the hypothesis. If true, the test statistic:

$$(5) \qquad W_t = \sum_{r=k+1}^{t} \frac{w_r}{s}$$

is normally distributed with a mean of 0, where s is the standard error of the regression fitted to all sample points and w_r is the ratio of the r^{th} residual to the r^{th} forecast variance. The forecast variance and residual use r-1 observations to estimate the model and then forecast the r^{th} residual and variance [see Greene (2003) for more on this procedure].

For both fish imports and exports, the cumulative sums fell within the 5 percent significance lines (see Figures 1 and 2), suggesting that the





Figures 1 and 2. CUSUM Test of Stability, 2002-2007

[1] Results of the model are not presented in this article but are available upon request.

residual variances are stable and that there were no significant structural changes in fish trade post mandatory COOL. However, for future research, a more comprehensive analysis of a range of fish species and fish forms should be performed to determine if COOL has resulted in shifts in the types of fish products traded, and also whether there have been shifts in the countries between which fish is traded.

Conclusions

Mandatory country of origin labeling (COOL) is required for certain covered commodities under the 2008 Farm Act. To be in compliance, food and agricultural producers will incur costs associated with tracking and labeling agricultural commodities. We simulate the impact of the COOL mandate listed in the 2008 Farm Act. Using a static global CGE model (STAGEM), we estimate the impacts of increased production costs on production, prices, trade flows, and social well-being.

Results show that increased costs of production for complying with COOL at the farm gate, processing, and retail levels, as well as for imported commodities, lead to decreases in the production of covered commodities, increases in covered commodity prices, and decreases in producer and consumer welfare. Though not captured in this analysis, consumers may also suffer from a decrease in product choice if higher production costs cause some producers to exit the market and also reduce imported varieties. Global agricultural trade is also reduced.

We are unable to model the potential reaction of consumers to mandatory COOL. Under voluntary COOL, producers chose not to label, indicating that consumer demand may not have been sufficient to cover the costs of implementing a voluntary COOL system. However, if some consumers are willing to pay a premium for country of origin labeled products, then the negative welfare effects may be reduced, or even reversed. In that sense, our results serve as a maximum negative impact, assuming AMS cost assumptions are realistic.

Future research will need to estimate actual implementation costs as well as consumer response to mandatory COOL in order to fully understand its impacts on production, prices, trade, and welfare.

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