Traceability and Quality Verification in the Canadian Beef Industry: Where To From Here?

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"Traceability" has entered the lexicon of the agriculture and food sector with a pervasiveness that is hard to ignore. The food-retailing sector is adopting traceability requirements for its suppliers at a rapid pace; individual supply-chain initiatives led by food processors, producer groups, or entrepreneurial third parties are building traceability into a wider product-branding strategy; in the livestock sector, agricultural producer organizations have introduced industry-wide animal-identification and traceability initiatives; governments are variously encouraging, enabling, or mandating traceability within their national food sectors. Canada is no exception to these trends. The Canadian beef sector, in particular, has a cattle-identification system that facilitates traceback through the farm to slaughter stages of the industry.

Traceback is only one potential function of the information infrastructure that comprises a traceability system. Credible verification of quality attributes to downstream food firms or to consumers lies at the heart of successful product differentiation. As the beef industry seeks to differentiate products, build branded beef programs, and facilitate value-chain alliances, a means to verify the presence of enhanced quality attributes becomes increasingly important. Verifying the presence of process attributes such as on-farm production methods related to animal welfare, the use of specific feeds, the production of "natural" beef, etc., requires new information flows along the supply chain. The credibility of quality claims and the potential damage to industry-wide reputation from misleading quality or safety claims requires effective traceability and process verification.

Clearly, traceability and quality verification are closely linked; however, they are not synonymous. Some traceback systems primarily offer a means to identify the source of contaminated food products or the movement history of potentially infected livestock efficiently and effectively, but are not intended to provide quality assurances with respect to production methods. Similarly, quality-verification programs may enable assurances with respect to a specific quality attribute (e.g., organic beef), without needing to identify the farm of origin. Nevertheless, inherent synergies exist in combining a traceback function with a quality-verification capability within the same information infrastructure. Traceability can add credibility to a quality-assurance guarantee. Yet traceability and quality verification remain separate functions, driven by different incentives, with different implications for private versus public costs and benefits.

This study explores the issue of full-chain traceability and process verification in the Canadian beef sector, evaluating whether the current cattle-identification system could or should be extended to a full-chain traceability system (i.e., beyond slaughter) and exploring the potential to combine traceability with more comprehensive process-verification information-management systems. A comparison of delivery through a national industry-wide system versus competing supply-chain initiatives is an important consideration in this analysis. A comprehensive literature review and in-depth semi-structured interviews with 12 industry stakeholders and experts were used to gather information.

What is Traceability?

A commonly accepted definition of the term "traceability" has yet to emerge, reflecting the diverse set of roles that traceability systems can play, from simple traceback to quality verification. The terms "identification," "traceability," and "verification" are often used interchangeably when in fact they are quite different. It may be relatively easy to identify livestock (ear-tags), but it is often more difficult to accomplish traceability, and even more difficult to verify identity, traceability, and quality (Smith et al. 2005b). Several authors distinguish between track-

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ing (following food and food ingredients forward to downstream buyers) and tracing (tracing food and food ingredients back to upstream suppliers) (Meuwiseen et al. 2004; Schwägele 2005). The ability to track or trace food does not necessarily provide buyers (consumers) with information on how that food was produced or whether it is safe. Quality (or safety) assurances provide additional information.

Traceability systems perform a diverse set of roles, responding to private-sector incentives to improve supply-side cost management and demand-side product differentiation, but also driven by public sector goals around reducing the social costs of food-safety problems. Broadly defined, five roles for traceability systems emerge: improved inventory and logistics management; improved management of food recalls in the event of a food-safety problem; limiting the broader (public) impacts of food-safety or herd-health problems; strengthening due diligence and liability incentives; and demand-side incentives, including facilitating product-differentiation strategies and providing economic signals to producers.

Individual firms have an incentive to adopt traceability systems to improve supply-chain management, including cost savings from improved logistics and inventory management, increased transportation efficiency and accuracy, and savings in labor costs (Golan et al. 2004; Jones et al. 2005). Following a food-safety incident, accurate traceability systems also enable firms to manage food recalls more efficiently by enabling potentially contaminated batches to be identified and located quickly, reducing the size and costs of a recall while containing the damage to brand-name reputation (e.g., Meuwissen et al. 2003; Hobbs 2004; Hobbs et al. 2005; Smith et al. 2005a; Golan et al. 2004).

Traceability also serves broader public and industry-wide functions related to the presence of information asymmetry and the potential for market failure in the delivery of safe food. The ability to trace potentially contaminated products can reduce the number of people exposed to unsafe food. Societal costs from a food-safety breach are reduced, including medical costs and lost productivity. From the perspective of the livestock industry, animal-identification and traceability systems enabling accurate and timely identification of animal location, origin, and movement enhance the control of

livestock epidemics, reducing the financial impact (externalities) on producers with unaffected herds. Traceability in this context is reactive—limiting the scope and impact of a problem—and has been a key motivation for the introduction of industry-wide livestock-identification and traceback systems (Hobbs 2004).

Traceability may also facilitate the allocation of liability for food-safety breaches. The ability to track products back along a supply chain allows civil and statutory liability for food-safety problems to be more easily established and provides an additional incentive for firms to practice due diligence (Hobbs 2004; Hobbs 2006; Golan et al. 2004). For firms and farms that practice due diligence, traceability systems may reduce their liability by demonstrating that they were not the source of a problem (Meuwissen et al. 2003; Smith et al. 2005a).

A final set of roles for traceability systems reflects demand-side incentives, including reducing information costs for consumers, implementing product differentiation strategies, and providing more accurate economic signals to producers (Meuwissen et al. 2003; Buhr 2003; Hobbs 2004; Smith et al. 2005b; Golan et al. 2004). Traceability systems that incorporate proactive quality verification or assurances reduce information costs for consumers through labeling the presence of credence attributes (e.g., animal-husbandry methods, use of pesticides, country of origin, information on labor standards, the use of non-GMO inputs, etc.). Thus traceability increases transparency in the supply chain, reassuring consumers and engendering trust.

Traceability and Quality-Verification Systems

Given the diverse set of functions that traceability and quality-verification systems can perform, it is no surprise that traceability initiatives exist in different forms within the livestock sector. In general, it is useful to distinguish between industry-wide traceability initiatives and individual supply-chain initiatives. In Canada the key industry-wide initiative relevant to the beef industry is the Canadian Cattle Identification Agency (CCIA), an industry-led organization established to ensure cattle identification and traceback from the producer through to point of slaughter. Radio Frequency Identification (RFID) ear tags with a unique identification number purchased from an authorized dealer must be at-

tached to each animal leaving the herd of origin. The CCIA primarily addresses the reactive functions of a traceability system: reducing recall costs for firms and minimizing the wider societal and industry impacts of food-safety or herd-health problems. The program began in 2001 on a voluntary basis, becoming a regulatory requirement in 2002, and is now well-established. A federal government agency, the Canadian Food Inspection Agency (CFIA), enforces the national mandatory animal ID program, with penalties for non-compliance.

The original mandate of CCIA was the provision of information (primarily to CFIA) to assist in tracing cattle from the packing plant to the farm of origin. This mandate has since expanded to include voluntary collection of birth dates for the purpose of age verification. Birth-date information for individual cattle is available to individuals and firms authorized (validated) in the CCIA database, but no additional information (e.g., herd of origin) is released. Age verification is one of several new directions introduced or under development by CCIA, and is important for access to key export markets in the wake of BSE. In January 2006 the CCIA released an enhanced database with added functionality for premise ID, animal movement and sighting, and age verification; planned initiatives include value-added quality assurances and group-lot identification (CCIA 2006a, 2006b).

Private-sector supply chains and branded programs have already begun to address the demand for quality verification. Supply-chain-based programs are obtaining premiums for products that respond to the demand for specific process attributes, including feeding programs, antibiotic and hormone-free, organic, and animal welfare (Farm Foundation 2006; Hobbs 2004). Indeed, numerous branded programs in the U.S., and to a lesser extent in Canada, undertake traceability for the purpose of production and process verification from farm to packer door. Tracking individual cuts across the packing floor is difficult given the speed and type of technology currently being used in the processing plants. Shift ID, which means that the meat is tracked to a specific shift in the packing plant, is being done, but individual animal ID has not been crossing the floor of the large-scale plants. Smaller and medium-sized processors have been able to build in traceability capability through the use of RFID and bar-coding technologies, along with within-plant segregation

strategies. Blurring the line between private supply-chain initiatives and industry-level programs are quality-assurance programs championed by producer associations involving certification of specified production processes and branding, but which do not necessarily restrict producers to operating within a single supply chain tied to a specific retailer—for example, Nebraska Corn Fed Beef (NCFB).

Several third-party companies offer data collection, storage, transfer and reporting services to the beef industry. These operate independently of the CCIA. Data collection and verification services are transaction-cost reducing: downstream firms face lower ex ante search costs and ex post monitoring costs if they can obtain age and quality-verification information from a reliable source. However, the accuracy of this information is often not verified independently.

Framework for Analysis: Elements of Effective Traceability Systems

For traceability systems to be effective they must be functional, reliable, and credible (Farm Foundation 2006), and must provide effective incentives to the appropriate supply-chain members. Traceability systems need to be functional, meaning they must be both technologically and economically feasible. They must be reliable in terms of delivering what is promised, and credible with all stakeholders, including consumers.

Functional

Evidence from the literature (Arana et al. 2002; Smith and Saunders 2005; Smith et al. 2005a) and from the interviews with technology experts suggests that full traceability (farm to fork) is technologically feasible. RFID, DNA, retinal scanning, and testing for the presence or evidence of certain animal treatments and feed regimes make it possible to verify not only age and source but process attributes. Proteins, fatty acids, and DNA-based methods have been used to identify species. The geographical origin of certain plant and animal materials can be "fingerprinted." Electronic data management of this information can be achieved using bar codes and radio frequency tags (Schwägele 2005).

While the technology exists for full traceability, the practicality of its application in the beef industry is a subject of much debate among industry experts. Many industry observers believe that the current technology is not capable of capturing the necessary information at the current speed of commerce in the Canadian beef industry. Individual animal-identification technology requires slower movement and processing of animals to be effective. Nevertheless, these technological problems are not insurmountable, and indeed new processing facilities can be designed with tracking capability built into the operating environment.

Technological feasibility is only half of the story. For implementation, the traceability system must also be economically feasible. Indeed, full, complete, and absolute traceability of all food products, food ingredients, and food attributes through all stages of the food-supply chain is probably an unattainable goal (Golan et al. 2004). While theoretically feasible for some product attributes (e.g., through the use of DNA technology), in practice the economic costs of implementing full, complete, and absolute traceability down to the level of all food ingredients and attributes render it extremely unlikely. Even DNA technology will not provide information on housing standards for calves or the labor standards for packing-plant workers. Only if the economic incentives are sufficiently strong in terms of a demand from the marketplace for this information will it be economically feasible to implement more complex systems of traceability coupled with quality verification.

Turning to the second element of a successful traceability system, any traceability program or system must be reliable in the outcomes it produces. The program must consistently meet the standards set, delivering reliable quality outcomes to meet stakeholders' needs and expectations. Audits and certification processes are necessary to ensure that a program is reliable. Reliability is closely tied to credibility. If the system does not provide reliable results it will not be credible. Compliance with the standards set for the program is essential if the program is to be credible with stakeholders and the general public.

When premiums are offered for the provision of information, or conversely when discounts are received for the absence of certain attributes or information, there are incentives to free-ride if audits or verification programs are not in place. In the U.S., access to export markets where importers have specific regulatory demands requires compliance with USDA Export Verification programs; for example, the No-Hormone Treated cattle program is an official Export Verification program for the EU market. The introduction of official verification programs was particularly important in securing access to export markets for U.S. beef in the wake of the U.S. BSE cases. Under the USDA Export Verification programs, firms must document their compliance with the requirements of the importing country (e.g. age verification, exclusion of specified risk materials such as spinal column, etc.). These programs involve not only strict requirements but also audit and certification processes verifying that quality standards are met.

Beyond food-safety-related assurances, the USDA Process Verification Programs go one step further, providing a framework for verifying quality-management processes within a firm or supply-chain alliance. These of course are voluntary and non-prescriptive—firms must document the "who, what, where, and how" of assuring quality in conformance with ISO quality-management standards, but the USDA program does not itself define the meat-quality parameters. Thus individual firms or supply chains can have their own unique differentiated, branded quality system approved under the USDA process-verification program. The USDA seal of approval provides credibility to the firm's quality-management system. As we have already seen, credibility is a critical dimension of any quality-verification program.

The current Canadian animal-ID program administered by CCIA is considered by most stakeholders consulted to be functional, reliable, and credible for the purpose of animal identification. The system has been tested by the recent BSE cases, proving to be effective in identifying the source of the problem and capable of dealing with the crisis in a timely manner. Beyond simple traceback, most individuals interviewed believe the private sector is best suited to undertake the collection and use of process information. Information only adds value for supply-chain participants when it can be marketed or used to create market opportunities. Producers need to have access to private marketing initiatives to create value from the information they produce. Most industry experts interviewed believe the market should drive the decision to collect and provide additional production and processing information.

Conclusions and Future Research Directions

This study examines the prospects for full-chain traceability and process verification in the Canadian beef sector. Industry and policy initiatives to date have largely been reactive: improving the ability to traceback animals in the event of disease problems. The industry consultations undertaken through this project revealed support for a proactive approach to safety and quality. Industry stakeholders are concerned that any traceability and process verification system be functional (cost effective and manageable for industry participants), reliable such that it consistently delivers the intended results, and credible with industry stakeholders and downstream buyers. The reputation of the industry is at risk should these programs not be reliable. Future research could examine the nature of the underlying supply-chain relationships necessary to deliver credible quality and safety assurances as a proactive marketing and industry-development strategy. It may be that a process-verification program, similar in scope and objectives to the USDA program, is warranted in Canada. If so, whether the CCIA, a federal government agency, or independent third parties would be the appropriate vehicles to verify quality programs is a question for future analysis.

The interviews revealed a reasonably high level of satisfaction with the current CCIA system in terms of the establishment of an effective animal-ID system and a general perception that the current system is sufficient for addressing animal-health and food-safety concerns. However, many of those interviewed acknowledge that what is considered "sufficient" in terms of information for the industry to function will grow over time. Consumers are becoming more discerning and requiring more information about the food they buy and consume. Age verification is considered by many to be essential for market access and is anticipated to be the next non-negotiable information requirement that will be needed for the industry to remain competitive in international markets.

In general, the information needs of various supply-chain members are poorly understood with respect to traceability or quality verifications. The industry consultations revealed a dichotomy of viewpoints: some believed that there is value in sharing carcass information with producers with the objective of improving quality, while others disagreed. Sharing production information (e.g., vaccines administered) has the potential to deliver cost savings, but verification is important since there are incentives to misrepresent this information. The costs and benefits of improving access (and timeliness of access) to the existing traceability and age verification information bear further investigation.

Industry representatives were unanimous in their belief that Canadian consumers have confidence in the safety of the Canadian food supply. While this may be true generally, there remains a significant information gap in truly understanding what motivates and influences Canadian consumers. How do consumers evaluate quality? What is the role of a brand versus a quality-assurance mark, and whom do consumers trust for providing credible quality assurances? Much of the attention to date has focused on traceability and quality programs at the producer, feedlot, and processor stages of the beef industry. We need a better understanding of the requirements of food retailers and the food-service sector with respect to traceability and quality verification, and the implications for the relationships between these firms and their suppliers. Future research could address this information gap in the Canadian context.

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