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Economic Impacts of Proposed Limits on Trans Fats in Canada

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The Issue

In response to growing concerns about coronary heart disease (CHD), the Government of Canada has recently taken policy measures to reduce Canadian trans fatty acid (TFA) consumption. The mandatory labelling of trans fat content in foods began in December 2005. The House of Commons also established a task force in November 2004 to develop a set of regulations to ban the sale of food products with a TFA content greater than 2 percent. The issue at stake is whether the mandatory content restriction has economic merit. While the mandatory TFA reductions could reduce heart disease and improve the health of Canadians, they also have the potential to increase economic costs faced by all aspects of the Canadian food oil complex, from primary producers to consumers. The goal of this article is to examine the impacts of a mandatory reduction of trans fat content by estimating the potential health benefits and potential adverse impacts on the agri-food sector.

Implications and Conclusions

In this study we found a ban on industrial trans fats would create health benefits in an order of magnitude larger than the increase in food industry costs associated with the ban. Theoretically we show that as long as significant health care costs are paid for through

private or public health care insurance, TFA labelling alone will not provide adequate incentives for a reduction in TFA consumption. In our empirical analysis, we estimate that several billion dollars in benefits would be forgone if reduction in TFA consumption were encouraged through labelling alone. We find a ban of trans fats in Canadian food products would be very beneficial from a health and health care–cost perspective, with relatively small costs of implementation and compliance. The present value of health care–cost savings of a ban to Canadians would exceed $19 billion. Oilseed growers, whose price is set in the global market, would be largely unaffected by a ban. Generally, the increase in cost will occur in the crusher and food processor sectors, through the cost of product reformulation and the substitution of higher cost high-oleic (HO) canola and soybean oils. These costs will ultimately be passed through to consumers, resulting in very modest increases in consumer expenditure. The overall result is a large net gain in welfare over a range of plausible scenarios.

Other observations: 1) mandatory labelling of trans fats in Canada and the United States has already resulted in the introduction of many trans fat–free products in the marketplace … far more than anticipated by the Food and Drug Administration (2003); 2) an immediate ban on trans fats may lead manufacturers to substitute canola and soy oils with tropical oils that are high in saturated fats, limiting the benefits associated with a trans fat ban; 3) genetic modification of canola and soybeans to increase high-oleic fatty acid offers considerable promise to address the demand for more stable oils. Delay in the regulatory approval of these products is costing Canadians many millions of dollars per year in health related costs; 4) food processors are likely to experience only a modest increase in cost, which is expected to be passed on to consumers.

Background

The evolution of nutritional knowledge regarding fat consumption has played an interesting and integral role in the development of the vegetable oil industry. Before the introduction of vegetable oils, animal fats, made up of butter, lard and tallow, were the fats of choice for most of the Canadian food industry. When research in the late 1950s and the 1960s found a correlation between animal fat consumption and heart disease (e.g., Ahrens et al., 1957; Keys, Anderson and Grande, 1965; Hegsted et al., 1965), the industry began to shift toward vegetable oils, including tropical oils; the latter (coconut, palm, and palm kernel oil) are by nature high in saturated fatty acids.

Mounting evidence that vegetable oils high in saturated fatty acids also increased the risk of coronary heart disease prompted food manufacturers and food service groups to begin evaluating alternative fats and oils (see, for example, Malla, Hobbs and Perger, 2005). Vegetable oils such as canola and soybean oils, with their high levels of linoleic acid and low levels of saturated fatty acids, were obvious healthy alternatives; however, canola and soybean oils were not functional in most processed food products (see figure 1). With the high levels of linoleic acid, neither oil was very stable when heated, and both

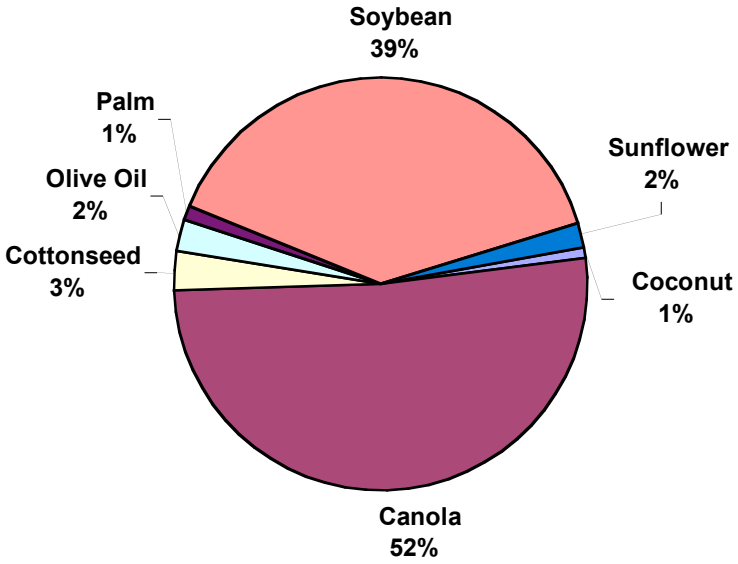

Figure 1 Total Canadian vegetable oil consumption by type.
Source: Dow Agroscience, publication date unknown

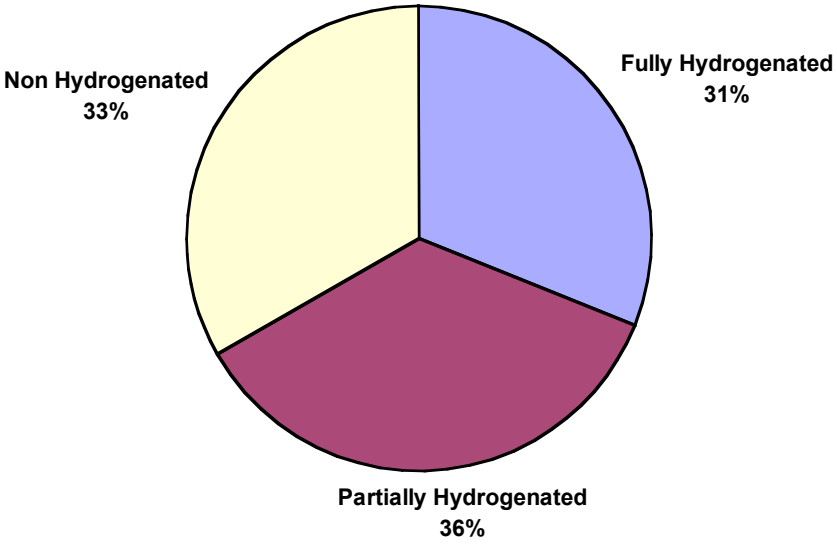

Figure 2 Total Canadian vegetable oil consumption by level of hydrogenation.
Source: Dow Agroscience, publication date unknown

became rancid easily. They did not perform the way saturated fats did during processing, nor did they provide the same sensory characteristics in the final food product.

To provide these missing functional properties, edible oil manufacturers hydrogenated the canola and soybean oils (see figure 2) (Dow Agroscience, 2005; List, 2004). By controlling the level of hydrogenation, manufacturers could make these vegetable oils suitable for a wide range of functions in the food industry. What was not widely known at

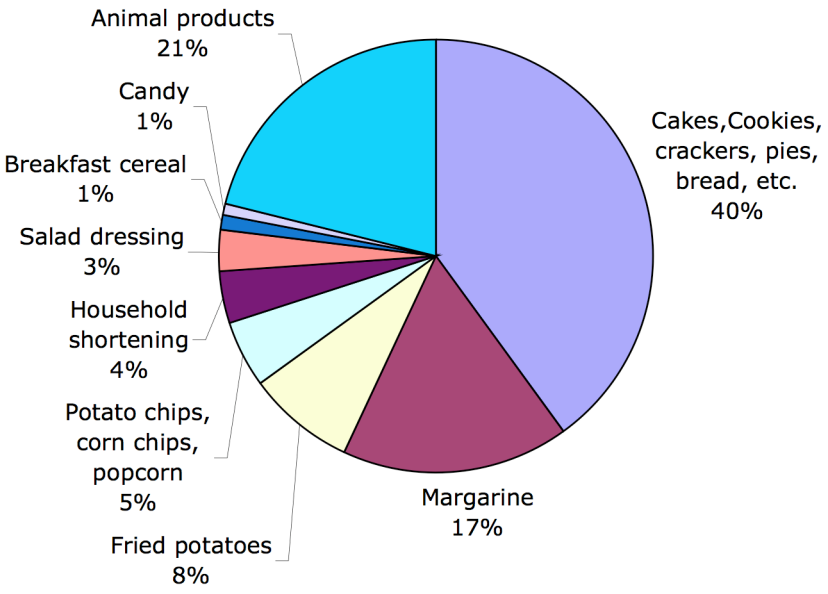

Figure 3 Major food sources of trans fatty acids for American adults.
Source: FDA Consumer Magazine, 2003

Table 1 Trans Fat Consumption in Canada, 2001

	Total annual cons.[1] (tonnes)	Individual daily fat cons.[2] (grams)	TFA content[3] (%)	Individual daily TFA cons.[4]	30% intake[5]
Shortening	360,986	32.97	19.84	6.54	1.96
Salad dressing	617,944	56.43	4.00	2.26	0.68
Margarine	128,736	11.76	20.14	2.37	0.71
Lard	12,980	1.19	3.50	0.04	0.01
Total	1,120,646	102.34	9.21	11.21	3.36

[1]Source of data: Statistics Canada, 2001.
[2] The per day consumption is calculated from the total consumption divided by 30 million (population) and 365 to get individual daily consumption.
[3] Estimates based on USDA, Nutrient Data Laboratory (1995).
[4] Individual daily TFA consumption is calculated by multiplying the individual daily fat consumption by the TFA content by category.
[5] We are assuming that only 30% of the total consumed oil is actual dietary intake. Much of the fat is thrown out after use rather than being consumed. In reconciling the difference between reported human use consumption of visible fats and the actual dietary intake, it is estimated that approximately 70% of these fats never reach the stomachs of consumers.
Source: Malla, Hobbs and Perger (2005, p. 178)

the time of introduction was that molecular changes occurred during the hydrogenation process. These changes created TFAs (see table 1 and figure 3). Recent research has demonstrated that these industrially produced TFAs not only increase levels of LDL cholesterol in the blood, they also lower the beneficial HDL cholesterol levels, leading

some researchers to conclude that, gram for gram, TFAs pose a higher risk for coronary heart disease than do saturated fatty acids (e.g., Ross et al., 2002; Sundram, French and Clandinin, 2003; Muller et al., 1998). It should be noted that TFAs are also produced naturally by bacteria in ruminant animals and are found in the animals' fat. Common sources of natural trans fatty acids include meat from ruminant animals, milk, cheese and butter (FDA, 2003).

This new health information regarding the deleterious effects of TFA is already causing a shift away from the use of hydrogenated oils. Some of this shift occurred through a voluntary process of product modification and voluntary labelling. This effect has been accelerated with compulsory food labelling in North America and the EU. Despite these trends, various consumer and health organizations have been applying pressure on the food industry to reduce or eliminate industrially produced trans fat from food products.

Conceptual Framework

Modeling the effects of a TFA ban requires consideration of both the costs and the benefits of compliance. The analysis is further complicated by consideration of the impacts of labelling and the prevalence of public health insurance. The market, viewed at the consumer level, is shown in figure 4. The supply curve *SS* represents the supply curve for a product containing TFA. The demand curve *DoDo* represents the demand curve of consumers oblivious to any adverse impacts of TFA. In this situation, the private firms will supply the TFA product and the quantity demanded will be equal to *Qo*.

The curve *MBsMBs* represents the social marginal benefits; this curve is equal to the private demand curve minus the health costs. The vertical distance includes both the private and the external health costs associated with TFA product consumption. The area *abcd* represents the total health costs of consumption, and the triangle *gab* represents the dead weight loss (dwl) from socially excessive consumption. If this area of dwl exceeds the area of economic surplus *cfg,* then a trans fat ban will increase economic surplus even if non-TFA substitutes are not available.

The impact of consumer information without TFA substitutes is also illustrated in figure 4. If consumers are perfectly informed about the health effects of TFA consumption and are aware of the TFA content of their food, and there are no non-TFA products available, then the informed consumers' demand shifts inward to *DiDi*. The new market equilibrium quantity shifts to *Qi,* reducing the socially excessive consumption. Unfortunately, even in this case, the consumers consume more than the socially optimal amount due to the health care externality.

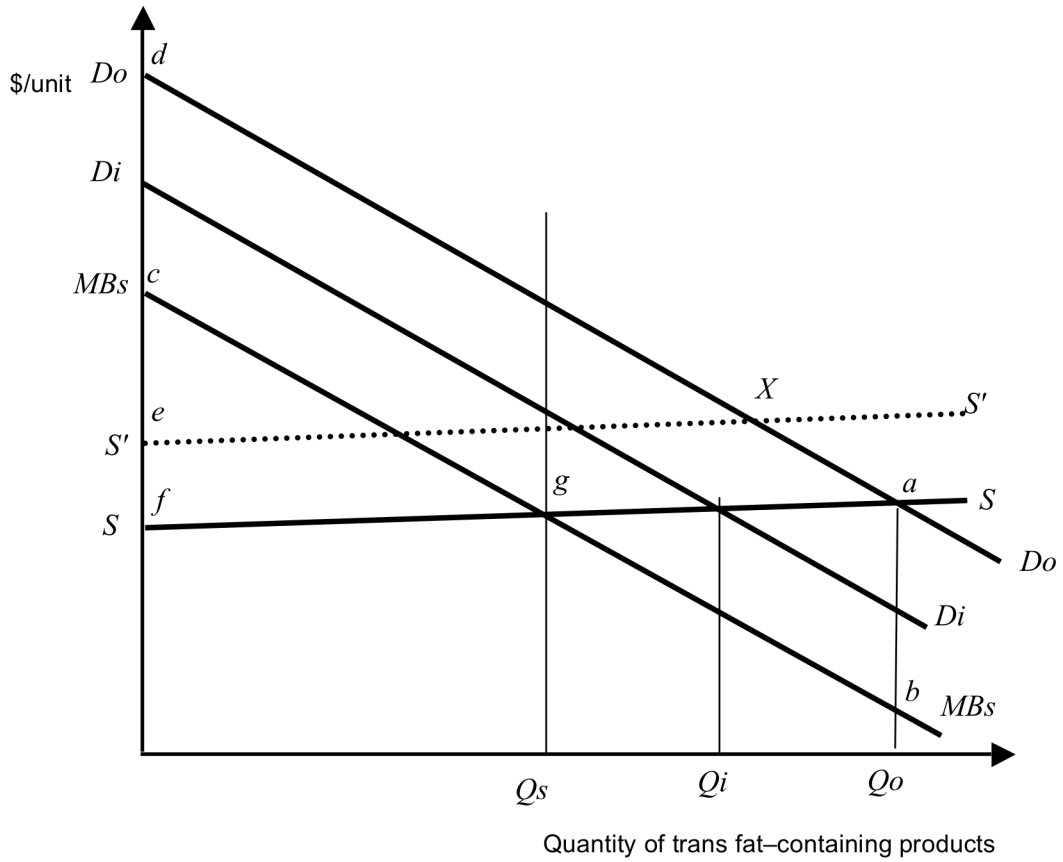

Figure 4 The market for trans fat–containing products.

Now consider the case where a trans fat ban is introduced and a product containing no TFA, a "non-TFA product", with exactly the same functional and taste properties, is produced on a supply curve *S′S′*, with the vertical difference above *SS* representing the additional marginal cost of production. Independent of any consumer knowledge, if a TFA ban is introduced in the presence of the TFA substitute, the new market equilibrium is at point *X.* At this point both upstream producer surplus and market consumer surplus are reduced but health care costs are eliminated, generating a net economic surplus equal to area *Xed*.

If TFA substitutes exist, the impacts of consumer information and labelling become considerably more complex. Some informed consumers could be willing to pay a sufficient premium for non-TFA products that the industry would find it profitable to shift to these higher cost non-TFA products. Even in this case voluntary labelling would differ from compulsory labelling in effectiveness. With voluntary labelling, firms wishing to differentiate their non-TFA products would label in an attempt to capture a greater market share, while firms with TFA products would have no incentive to label. This lack of labelling would leave the consumers of these products ignorant of the TFA content. Thus

one would expect a more widespread adoption of non-TFA products under a mandatory labelling scheme. Even with mandatory labelling, if either the private health costs are too small to warrant non-TFA production, or there are some consumers that remain ignorant, then a private market for some TFA products will persist and continue to generate health care costs.

Assessing the Costs and Benefits of Canadian TFA Policies

The efficacy of policies designed to limit the consumption of TFAs will ultimately be determined by both the costs and the benefits of each. A regulation to restrict TFA use would increase costs to consumers, but at the same time would reduce private and public health care costs. Even a labelling policy requires resources for product testing, product reformulation and new design.

In this section we estimate the potential costs and benefits of three different policies: 1) a voluntary labelling system; 2) a mandatory labelling system; and 3) a ban on foods with greater than 2 percent TFA. The voluntary labelling scenario provides a relevant counterfactual to the other policies, because this is the most plausible situation in the absence of mandatory labelling or a ban. The effects of mandatory labelling are included as a scenario because this policy was recently introduced in Canada, and the effects of a TFA ban must be considered within this context. Finally, we examine a TFA ban, given that this policy is currently under consideration in Canada.

Data and relationships are drawn from a number of sources to estimate the costs and benefits for each of the three scenarios. We draw extensively on estimates published in the Federal Register of the U.S. Food and Drug Administration in 2003. This extensive study was done as a requirement prior to the introduction of the Federal Marketing Order requiring the mandatory labelling of TFA in the United States. Both the cost and the benefit estimates were subjected to public comment and scrutiny prior to the final estimates. The FDA relationships are applied to estimates of Canadian consumption, production and health costs.

The parameters and assumptions used to calculate the costs and benefits are shown in table 2. The best estimates, low estimates and high estimates are shown in separate columns. The best estimates are based on what we believe to be the most plausible set of assumptions. The low estimates are intended to provide very conservative estimates of net benefits, forming a lower bound for the plausible range. The high estimates are intended to provide an upper bound.

In our analysis we estimate that the effects of Canadian TFA policy on Canadian oilseed growers would be virtually zero, and we exclude this effect. Vegetable oil prices are determined in global markets, and Canada is an exporting country. Given that Canada has less than 1 percent of the world's population and only a small market share, changes in Canadian consumption would have little price impact. Furthermore, TFA policy is likely to have very little impact on total Canadian vegetable oil consumption. Finally, any

Table 2 Description of the Parameters, Data and Assumptions

Scenario descriptions	Best estimate	Low estimate	High estimate
Discount rate	5%	5%	5%
% Can versus number of US products	80	80	**40**
US reformulation cost ($millions) .1%	18.86	**37.71**	9.93
US testing and labelling cost	245.3	**490.6**	245.3
Daily % intake of energy from TFA in 2000	5.86	5.86	5.86
% reformulation voluntary labelling adoption 2006	15	15	15
% reformulation voluntary labelling adoption 2010	30	30	30
% reformulation man. labelling adoption 2006	25	25	25
% reformulation man. labelling adoption 2010	50	50	50
% reformulation with ban 2006	30	30	30
% reformulation with ban 2015	80	**80**	90
% mono/poly adoption voluntary labelling 2006	30	30	30
% mono/poly adoption voluntary labelling 2010	40	40	40
% mono/poly adoption with man. labelling 2006	30	30	30
% mono/poly adoption with man. labelling 2010	50	50	50
% mono/poly adoption with ban 2006	30	30	30
% mono/poly adoption with ban 2010	80	**80**	**90**
% mono/poly sub that is non HO	20	20	20
% change in CHD / % mono red TFA	2.87	**1.44**	2.87
% change in CHD / % sat red TFA	1.84	**0.92**	1.84
Annual Canadian CHD cost ($millions)	18,473	9,237	18,473
Lag for CHD effect (years)	3	3	3
HO production costs ($/t/seed)	$44	$44	$44
HO production costs ($/t/oil)	$110	**$220**	$110
2000 Canadian hydrogenated veg. oil disappearance	233,000	233,000	233,000

Source: authors' estimates and other sources (see text)

small reduction in global oil demand brought about by Canadian TFA policy is likely to be more than offset by an increase in demand for high-oleic canola, which has already become a significant crop.

With the exception of a modest price increase, we assume that a TFA ban would significantly restrict neither the quality of products available nor consumer choice. We arrived at this simplified assumption after observing the changes in products that had already taken place as a result of TFA labelling and discussing the issue with a number of industry experts. Most of the discussion centered around the availability of laminated bakery products, which tend to be layered with hydrogenated vegetable oils. These industry experts indicated that the short-run response in most cases would be reformulations based on tropical oils and animal fats. These more traditional formulations had an appealing taste to consumers but were rejected historically with the belief that a move to hydrogenated vegetable oils was healthier; a move back to these more traditional

recipes will be welcomed by the taste buds of many consumers. Furthermore, FDA (2003) found a wide range of TFA currently in each product category, suggesting that low-TFA formulations already exist and new reduced-TFA shortening formulations are commercially available. Lacking tangible examples of products that would cease to exist in the case of a mandatory limit of 2 percent TFA, we do not include the loss of consumer choice as a cost in our analysis.

For the "best estimates" we assume that the Canadian food suppliers will incur labelling costs on 80 percent of the number of products that are affected in the United States. While the Canadian market is far smaller than the U.S. food market, supermarkets and food lines are of similar dimensions. FDA (2003) estimates that it will cost $245 million dollars to test and relabel all affected food products with mandatory labelling. The FDA (2003) reports a cost of $18.86 million (CDN) dollars in reformulation costs to achieve a reduction of .1 percent in daily energy from TFA. We linearly apply this ratio of cost to TFA reductions achieved in each scenario. The daily intake of TFA is assumed to be 5.86 percent of daily energy requirements, which is the amount reported in the FDA (2003) study.

Each policy scenario has a unique TFA reduction profile. For example in the best estimate we assume that, by 2006, 15 percent of products were reformulated in the presence of voluntary regulation, and in the presence of mandatory labelling and a trans fat ban these numbers would increase to 25 and 30 percent respectively. In the case of voluntary labelling we estimate TFA reduction would increase linearly to 30 percent by 2010 and then level off. This is in contrast to a TFA ban, where TFA reduction would linearly increase to 80 percent by 2015 and then level off.

The initial substitution to saturated fats with a greater shift to mono and polyunsaturates over time is also reflected in our estimates. For instance, with mandatory labelling, in 2006 only 30 percent of the TFA substitution will be made up of unsaturated fats, increasing to 50 percent by 2010.

The reduction in TFA will also affect the use of HO canola and oil production costs. We assume that any substitution with unsaturated fats beyond 20 percent will be sourced from HO Canola. For example, with a TFA ban, by 2015 there is assumed to be an 80 percent substitution of non-saturates for TFA. Of this amount, 60 percent will come from HO Canola. Based on Gray, Mall and Perlich (2005), we assume that this HO oil is produced at a cost of $110 per tonne, which is incorporated into the reformulation costs.

The health care–cost savings are based on the relationships reported in the FDA report (2003) as applied to Canadian CHD health costs (Health Canada, 1998). It is assumed that every 1 percent reduction in daily energy from TFA that is replaced by energy from saturated fatty acid reduces the incidence of CHD by 1.84 percent. An even greater reduction of 2.87 percent in CHD is achieved if the TFA is replaced with mono or polyunsaturated fatty acids. The resulting reduction in CHD is applied to the Canadian annual cost of $18.4 billion per year. Similar to the FDA, in each case we use a linear

relationship between TFA consumption and health outcomes, as we could not find information about second-order effects.

The assumptions for the low estimate are modified to deliberately take extreme values for additional costs, while at the same time deliberately reducing the benefits from TFA reduction. The high estimate assumes that most of the reformulation costs will be born in the U.S. food lines. The figures printed in bold in table 2 for these scenarios differ from those used in the best estimate.

Results

The estimated costs and benefits for each scenario are shown in table 3, based on the assumptions and data/relationships presented above. The reported amounts are present value figures for the period 2006 to 2025 based on a 5 percent real discount rate.

Scenario 1 presents the potential costs and benefits, and in turn estimates the benefit to cost (B/C) ratio, of a voluntary labelling system. Specifically, for the best (most realistic) estimate the testing/labelling cost is $66 million while the product reformulation cost is $295, which together account for $361 million in expenditures. Furthermore, the CHD health benefit estimate is equal to $7,357 million. Hence, the B/C ratio associated with voluntary labelling is 20.4:1. For the low-estimate scenario (conservative estimates) the B/C ratio is 2.5:1, while for the high estimates (optimistic estimates) the B/C ratio is a very high 40.3:1.

Scenario 2 presents the potential costs and benefits of a mandatory labelling system, as well as the B/C ratio. The testing/labelling cost, where all products are tested and labelled, is equal to $187 million. The mandatory labelling stimulates an increased product reformulation cost of $471 million. Thus, the total estimated industry cost of mandatory labelling is equal to $658 million. However, the CHD health benefits are equal to $12.57 billion. Consequently, for the best estimate the B/C ratio when mandatory labelling is implemented is 19.1:1. This B/C ratio is reduced to 2.4:1 for the low estimate and increases to 47.1:1 for the high estimate.

Finally, scenario 3 estimates the benefits and costs when a ban on foods with greater than 2 percent TFA is implemented. Specifically, the testing/labelling cost is equal to $187 million and the product reformulation cost is $754 million, accounting for a total industry cost of $941 million. Under this scenario the CHD health benefits increase to $19.54 billion, resulting in a B/C ratio of 20.8:1. For the low-estimate scenario, the B/C ratio is equal to 2.6:1, while for the high-estimate case it is a very large 51.5:1.

To evaluate the net economic benefits of the mandatory labelling system, we compare the benefits and costs of mandatory labelling to the voluntary labelling system that most likely would exist in the absence of mandatory labelling (i.e., scenario 2 vs. 1). For the best estimates (most realistic), the additional costs the industry would incur switching from voluntary labelling to a mandatory labelling system amount to $297 million ($121 million in testing/labelling costs and $176 million in product reformulation costs).

Table 3 Benefits and Costs of Voluntary and Mandatory Labelling and TFA Ban

		Results		
Scenario	**Cost or benefit category**	**Best estimate**	**Low estimate**	**High estimate**
1) voluntary	testing/labelling $M	66	132	66
	product reformulation $M	295	590	117
	total cost $M	361	723	183
	CHD health benefits $M	7,357	1,839	7,357
	benefit/cost	20.4	2.5	40.3
2) mandatory	testing/labelling $M	187	374	93
	product reformulation $M	471	943	174
	total cost $M	658	1,316	267
	CHD health benefits $M	12,568	3,142	12,568
	benefit/cost	19.1	2.4	47.1
3) TFA ban	testing/labelling $M	187	374	93
	product reformulation $M	754	1,508	317
	total cost $M	941	1,881	410
	CHD health benefits $M	19,541	4,885	21,109
	benefit/cost	20.8	2.6	51.5
2 versus 1	testing/labelling $M	121	242	27
	product reformulation $M	176	352	57
	total cost $M	297	594	84
	CHD health benefits $M	5,211	1,303	5,211
	benefit/cost	17.6	2.2	61.8
3 versus 2	testing/labelling $M	0	0	0
	product reformulation $M	282	565	143
	total cost $M	282	565	143
	CHD health benefits $M	6,973	1,743	8,541
	benefit/cost	24.7	3.1	59.7

Source: authors' calculations

Meanwhile the extra CHD health benefits of the mandatory labelling system are equal to $5.21 billion. Consequently, the B/C ratio or the net economic benefits of introducing a mandatory labelling system in Canada are equal to17.6:1. This B/C ratio is reduced to 2.2:1 for the low estimate and increases to 61.8:1 for the high estimate.

These results suggest mandatory TFA labelling is very advantageous for the Canadian economy. While this is a remarkably high B/C ratio, the FDA (2003) analysis estimated that mandatory labelling in the United States would have a B/C ratio of over 170:1. The somewhat lower B/C ratio for Canada is largely a result of similar product testing and labelling costs with a much smaller population base.

Finally, comparing the effect of a TFA ban to that of a mandatory labelling system (i.e., scenario 3 vs. 2), the ratio of additional benefits and costs is 24.7:1. The additional

CHD health benefits are $6.97 billion as compared to the additional product reformulation cost of $282 million. For the low-estimate scenario the B/C ratio is 3.1:1 while for the high estimate-scenario the B/C ratio is a very high 59.7:1. This suggests substantial economic gain would be achieved from moving beyond labelling to a regulatory restriction of TFA use.

Overall Effects of TFA Reduction

In each of the three policy scenarios examined we found a very high benefit to cost ratio. While voluntary labelling resulted in substantial net benefits, the extent of net benefits was further increased with mandatory labelling. The greatest net benefits were generated with a ban on food products with TFA content above 2 percent. These results are consistent with a conclusion that the health care costs associated with TFA consumption are significant and can be effectively addressed with a consumer shift toward non-TFA products, given appropriate policies that incorporate information and health externalities.

The analysis reported in this article combined information from a number of sources to estimate the costs and benefits of yet untested policy that could have widespread impacts both on the foods produced and consumed in Canada and on health care costs. Arriving at estimates required the use of information that was available at the time of study. The estimates reported in the sensitivity analysis reflect the range of uncertainty in this assessment. The consistently high benefit to cost ratio suggests that policies to restrict TFA consumption have a large potential payoff.

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