Milked and Feathered: The Regressive Welfare Effects of Canada's Supply Management Regime

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Au Canada, la production et le commerce de produits laitiers et de volaille sont soumis à un système de gestion de l'offre (GO) : des quotas sont imposés aux producteurs, et des contingents tarifaires limitent les importations. Plusieurs partenaires commerciaux du Canada cherchent à obtenir un meilleur accès au marché canadien de produits laitiers et de volaille dans le cadre de négociations d'accords commerciaux préférentiels, et cela a ravivé le débat sur la GO. Dans cet article, nous analysons une critique de ce système de GO, selon laquelle le régime a des effets dégressifs sur la répartition des revenus. Pour évaluer la réaction des consommateurs à des changements de prix des produits laitiers et de volaille, nous utilisons le modèle d'approximation de la demande EASI, que nous appliquons à des données tirées de l'Enquête sur les dépenses alimentaires. Les paramètres du modèle nous permettent de comparer la situation actuelle (avec GO) et ce qui se produirait sur un marché libéralisé. Nos résultats montrent que le régime actuel est très dégressif, puisqu'il impose une charge annuelle d'environ 2,3 pour cent (339 $) aux ménages les plus pauvres, alors que cette charge n'est que de 0,5 pour cent (554 $) pour les ménages les plus riches. De plus, cette charge est plus importante encore dans le cas des ménages avec enfants.

Mots clés : gestion de l'offre, estimation de la demande, impôt dégressif

The production and trade of dairy and poultry products in Canada are controlled by a system of supply management (SM). Output is regulated with production quotas, and imports are restricted through a system of tariff-rate quotas. Many of Canada's trading partners are seeking better access to Canadian dairy and poultry markets in negotiations over proposed preferential trade agreements. These pressures have renewed debate about the future of SM in Canada. We investigate one criticism of SM: that high prices for dairy and poultry products impose regressive distributional effects on Canadian consumers. We apply the Exact Affine Stone Index demand model to data from the Canadian Food Expenditure Survey to estimate consumer responses to price changes for dairy and poultry products. Parameters from the demand model are used to generate welfare comparisons between the current SM regime and a counterfactual liberalized market. Canada's SM policies are highly regressive, imposing a burden of approximately 2.3 percent ($339) of income per year on the poorest households, compared to 0.5 percent ($554) for the richest households. The burden is larger for households with children.

Keywords: supply management, demand estimation, regressive tax

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Introduction

The production and trade of dairy and poultry (chicken, turkey, and eggs) products in Canada are controlled by a system of supply management (SM). SM regulates output of these products and restricts imports through a system of border taxes, and it has generated a prolonged period of high prices in Canada's protected market. Canada's SM policies have delivered high and stable incomes to producers but at a high cost to society through lower productivity and high prices for consumers (Schmitz 1983; Veeman 1982). This trade-off has been politically acceptable to national political parties (House of Commons 2009) despite the fact that one of the primary criticisms directed toward Canada's SM policies is that they distort food prices in a manner that has regressive welfare effects across the income spectrum. Several popular press articles (e.g., *Financial Post* 2010; *Globe and Mail* 2012; *National Post* 2007) and researchers at policy research institutes (e.g., Hall Findlay 2012; Institute for Competitiveness and Prosperity 2010; Montreal Economic Institute 2007) have referred to Canada's SM policies as a form of regressive taxation on consumers.

The border protection for Canada's SM industries has come under increasing pressure in recent years as Canada has entered negotiations for new preferential trade agreements. Many of Canada's trading partners are seeking better access to Canadian dairy and poultry markets in return for reciprocal concessions on Canadian exports. Though it is unclear how far current negotiations may go in liberalizing Canada's SM industries, the prospect of lower import barriers for dairy and poultry has generated renewed interest and debate in Canadian policy circles and in the popular press.

We contribute to the debate about liberalizing Canada's dairy and poultry markets by answering the question: how regressive are Canada's SM policies for consumers? There are two aspects to the assertion that SM policies are regressive. The first is that higher prices generated by SM policies transfer income from a large number of lower-income (on average) consumer households to a small number of higher-income producer households.[1] As of 2009, the average Canadian household income was approximately $68,000 compared to $110,000 for dairy-producing households and $119,000 for poultry- and egg-producing households (Statistics Canada 2011). Hence, SM policies can be viewed as transferring income from lower-income households to higher-income households, on average. A thorough analysis of the extent to which producers benefit from SM would consider a range of issues including how rents are apportioned along the supply chain owing to asymmetric bargaining power between producers, processors, and retailers (Gervais and Devadoss 2006) and the capitalization of program benefits into the price of production quotas (Barichello, Cranfield, and Meilke 2009).

We investigate a second aspect of regressivity that is derived from Engel's law, which asserts that the share of income spent on food is inversely related to income. A public policy that increases food prices for consumers therefore imposes a heavier burden on households at the low end of the income spectrum. Canadian households in the lowest income quintile spend approximately 16 percent of their total expenditures on food, while households in the highest quintile spend approximately 8 percent on food (Agriculture and Agri-Food Canada 2012). Higher dairy and poultry prices would therefore impose a proportionally larger penalty on households that spend more of their incomes on food.

We begin by estimating the demand elasticities of each SM commodity by income quintile, where elasticities are estimated using the Exact Affine Stone Index (EASI) demand model developed by Lewbel and Pendakur (2009). We use household-level data from the 2001 Statistics Canada Food Expenditure Survey (FES). The parameter estimates from the EASI demand model are combined with a counterfactual scenario for the prices of SM products if these policies were to be dismantled and Canadian markets became competitive. We calculate compensating variations and evaluate the economic burden that the current SM system imposes on consumers across the income spectrum.

We take several steps to construct a conservative counterfactual price scenario. Further, the use of compensating variations (instead of equivalent variations or consumer surplus) means that we present lower-bound estimates of the implicit tax resulting from SM. Finally, our household spending data do not include food consumed at restaurants, which implies that we do not capture the welfare impacts of SM on food consumed away from the home. Our results can therefore be viewed as conservative estimates of the impact of SM on Canadian consumers.

We find that SM imposes an implicit tax on consumers of approximately 0.84 percent of annual household income, averaged across all income quintiles. We present evidence that this result is robust to an alternative counterfactual scenario, which indicates that the burden is 0.82 percent of annual household income. Several interesting results emerge when we estimate the welfare impacts of SM across income quintiles. Households in the lowest income quintile face an implicit tax of 2.29 percent of household income, whereas households in the highest income quintile pay an implicit tax of 0.47 percent. This suggests that Canada's SM system is regressive: the poorest households incur a burden relative to income that is approximately five times larger than that of the richest households. Further, our estimates indicate that low-income households (in the bottom two quintiles) with children pay between $466 and $592 extra per year for dairy and poultry products as a result of SM.

The remainder of the article proceeds as follows. In the following section we present a brief overview of Canadian SM. The third section briefly describes the censored EASI demand model and the FES data used to estimate price elasticities of demand for the SM commodities. A more complete description of the empirical model is included in the technical appendix. We describe the construction of two counterfactual price scenarios in the fourth section followed by a presentation of the welfare analysis in the fifth section. We conclude with a discussion.

An Overview of Canada's Supply-Managed Industries

Supply-managed industries are governed by three operational pillars: production controls, producer prices that are based on cost-of-production calculations, and import controls.[2] Producers are required to hold production quota to ship products to provincial marketing boards, who then sell to processors and other end-users. These production quotas can be traded on exchanges and are valuable assets; dairy quota prices reached $42,000 ($/kg butterfat per day) in British Columbia in 2013 (Agriculture and Agri-Food Canada n.d.). National production quotas are allocated between provinces, and volumes are controlled by marketing boards to maintain target prices for SM products.

Producers of SM products receive a price that is based on a cost-of-production calculation, which includes input costs plus a producer profit. Raw milk is produced at the farm level and is used as an input in the production of a range of dairy products (e.g., butter, ice cream, cheese) that sell for different prices. Producers receive weighted average prices for their raw milk, calculated as functions of the end uses of the raw milk. Chicken producers receive a price for whole birds, as determined by provincial marketing boards.

Border measures are applied to imported dairy and poultry products to maintain high domestic prices. Imports of SM products were traditionally controlled through import quotas, but World Trade Organization (WTO) member countries agreed to eliminate quantitative restrictions in the WTO's Uruguay Round Agreement on Agriculture. These import quotas were converted to tariff-rate quotas in 1995 and include a low tariff rate on a negotiated volume of imports (Canada's "minimum access commitments") and a high tariff rate applied to imports beyond that volume. The over-quota tariff rates are set prohibitively high (e.g., 299 percent *ad valorem* for butter) and act as de facto import quotas.

The crux of liberalizing Canada's SM industries is reducing border taxes on imports; the system of domestic production controls and cost-of-production pricing is entirely dependent on protection from relatively low-priced foreign products. There are two avenues through which the protections afforded to SM industries could be liberalized. The first is an increase in the volume of products that would be allowed into the country at the low within-quota tariff rate. The second method of liberalization is to lower the over-quota tariff rates that currently act as de facto import quotas.

Canada has recently concluded negotiations on a preferential trade agreement with the European Union, under the banner of the Comprehensive Economic and Trade Agreement. This agreement allows for a very small increase in the quantity of cheese that can enter the Canadian market under the over-quota tariff rate. However, the increase is not large enough to significantly affect Canadian cheese prices or dairy market structure.[3] WTO negotiations remain stalled, and the recent Ministerial Conference in Bali did not generate any new disciplines that would affect Canada's SM industries. Also, the most recent proposals to emerge from WTO negotiations are unlikely to significantly affect the market for SM products in Canada (Rafajlovic and Cardwell 2013). Canadian negotiators are also involved in the development of the Trans-Pacific Partnership, which has included proposals to moderately liberalize trade in Canada's SM products. However, some argue that significant liberalization in dairy trade is unlikely to emerge from the Trans-Pacific Partnership and that any adjustments to the Canadian industry would be minor (Rude and An 2013).

Demand Model and the FES

We estimate the price elasticities of demand for SM products by income quintile using the EASI demand model developed by Lewbel and Pendakur (2009). We use household-level consumption data on a set of highly disaggregated food categories, which leads to a substantial number of households with zero expenditure in one or more of the food categories over the sample period. We use the two-step procedure developed by Shonkwiler and Yen (1999) to account for the selection bias that might arise as a result of zero expenditure. Since we estimate the price elasticities of demand within each income quintile, there is the possibility that the unit prices observed in the data reflect choices over quality and are therefore endogenous. We use quality-adjusted prices following Cox and Wohlgenant (1986) to account for this possibility. We estimate the parameters of a 19-good demand system, incorporating household expenditures on all food consumed at home. The details of the EASI demand model are provided in the technical appendix.

Data

We use data from the 2001 Statistics Canada FES to estimate the price elasticities of demand for SM commodities that vary across household income quintiles. Statistics Canada conducted six rounds of the FES, with

the most recent in 2001. In the 2001 survey, respondents kept detailed diaries of all food expenditures grouped into 210 categories, including food at home and food away from home. The FES 2001 is considered to be a high-quality survey because respondents were asked to submit grocery store receipts with expenditure diaries. The survey included interviews with 5,643 households in ten provinces in 2001; 5,391 households reported two weeks of data, and 252 households reported one week of data. The average weekly expenditure was calculated by simple averaging.

We estimate one demand system that includes the following food categories: beef and veal, pork, chicken, turkey, fish, other meat, eggs, milk, cheese, fresh yogurt, ice cream and frozen yogurt, butter, bakery, pasta and cereals, fruit, vegetables, fats and oils, beverages, and other food at home. The unit of measurement for each food category is converted to kilograms based on conversion factors developed by Agriculture and Agri-Food Canada (Pomboza and Mbaga 2007).

The survey collects information on quantities consumed and expenditures for each of our food categories. The price of each item is not provided, so we derive household-specific prices within each food category as unit values. However, a household-specific unit value cannot be computed for those food categories that the household does not consume during the two-week survey period. We replace missing prices with average unit values among all consuming households; averages are calculated by geographical region (including the Atlantic provinces, Quebec, Ontario, the Prairie provinces, and British Columbia) and the size of the area of residence (defined as rural, population less than 30,000, and population over 30,000). Households with zero total weekly food expenditure or zero total weekly food expenditure in stores, as well as households that do not state their income, are excluded from the sample. We are left with a sample of 4,976 households in the full food demand model.

We also estimate separate demand models by income quintile. The FES reports the income of each household in bins, so we do not observe each household's income. We construct a proxy measure for household income using average household income within each bin calculated using data from the 2001 Survey of Household Spending. As an example, the average income in the $30,000–$39,999 FES income bin is the sample weighted average household income for those households in the Survey of Household Spending whose household income is in the $30,000–$39,999 range. We adjust our proxy for FES household income for different family sizes using an equivalence scale. We use the Organisation for Economic Co-operation and Development (OECD) equivalence scales, where the oldest person in the family receives a factor of 1, family members aged 15 and over receive a factor of 0.5, and family members under age 15 receive a factor of 0.3. Households in the FES are then divided into income quintiles after equivalence-scale adjustment using FES sample weights.

In addition to budget shares, unit values, and total food expenditures described above, we incorporate several demographic variables to control for household characteristics. We include the age and gender of the head of the household, the number of household members, dummy variables indicating urbanization (rural, population less than 30,000, and population greater than 30,000), regional dummies (Atlantic, Ontario, Quebec, Prairie, British Columbia), quarterly dummies, and household types (couples without children, couples with children, one-person households, lone-parent households with children, and other households). Biweekly frequency of shopping trips and biweekly expenditure on food away from home are included in the first-step equation that describes the decision to purchase but omitted from the second-step equation.

Table 1 presents mean unit values, budget shares, and the share of households with children.[4] The summary statistics are reported for the aggregated data set and by income quintile. Note that the unit values tend to be higher in the upper-income quintiles. This likely reflects higher-income households' purchases of higher-quality food and willingness to pay premiums for convenience. Within dairy, higher-income households spend larger shares of their food budget on cheese and smaller shares on fluid milk. Higher-income households spend larger shares of their food budget on fish, chicken, and beef.

Canadian Dairy and Poultry Markets without SM

To evaluate the effects of SM policies on consumers, we require estimates of how retail prices for dairy and poultry products would differ from current prices if the SM framework were to be dismantled and Canada's dairy and poultry markets were liberalized.[5] Such a price scenario is unobservable, so we construct counterfactual prices to estimate post-SM consumer prices for dairy and poultry products. We base this counterfactual on the assumption that Canada is a small-country price taker for SM products.

Canada is typically modelled as a small country in partial equilibrium models of SM markets (e.g., Moschini and Meilke 1991; Rude and An 2013) because of the relatively small share of global production and trade accounted for by Canadian dairy and poultry. For example, Canada's shares of global dairy and chicken production are 1.6 percent and 1.4 percent, respectively, and Canadian production is less than 10 percent of US production (US Department of Agriculture n.d.). Canada's shares of global trade in dairy and poultry

Table 1: Summary Statistics

Variable	Aggregate Mean (SD)	Income Quintile 1 Mean (SD)	2 Mean (SD)	3 Mean (SD)	4 Mean (SD)	5 Mean (SD)
Prices ($/kg)						
Beef and veal	8.33	7.92	7.82	8.19	8.49	9.30
	(3.27)	(2.81)	(2.82)	(3.37)	(3.21)	(3.91)
Pork	8.46	8.06	8.24	8.47	8.64	8.92
	(2.12)	(1.89)	(2.07)	(2.17)	(2.08)	(2.30)
Chicken	7.46	7.04	7.21	7.36	7.78	7.96
	(2.97)	(2.91)	(2.85)	(2.96)	(2.99)	(3.04)
Turkey	8.85	8.58	8.71	8.77	8.98	9.26
	(2.37)	(2.16)	(2.21)	(2.39)	(2.57)	(2.41)
Fish	12.11	11.40	11.81	12.04	12.19	13.24
	(4.23)	(3.25)	(3.69)	(4.58)	(4.03)	(5.26)
Other meat	8.78	8.11	8.12	8.59	9.29	9.84
	(3.52)	(3.21)	(3.26)	(3.22)	(3.67)	(3.88)
Milk	1.16	1.18	1.14	1.16	1.16	1.15
	(0.31)	(0.29)	(0.28)	(0.28)	(0.33)	(0.38)
Yogurt	4.23	4.25	4.29	4.15	4.23	4.24
	(1.09)	(0.92)	(1.15)	(1.01)	(1.16)	(1.20)
Butter	6.83	6.76	6.75	6.80	6.92	6.95
	(0.87)	(0.81)	(0.80)	(0.78)	(0.84)	(1.06)
Cheese	10.92	10.43	10.63	10.94	10.94	11.78
	(3.43)	(2.98)	(3.49)	(3.24)	(3.32)	(3.96)
Ice cream	5.50	5.30	5.42	5.32	5.66	5.85
	(3.04)	(2.58)	(2.74)	(2.61)	(3.69)	(3.34)
Eggs	3.46	3.42	3.39	3.43	3.50	3.54
	(0.65)	(0.57)	(0.61)	(0.67)	(0.65)	(0.76)
Bakery	4.70	4.23	4.45	4.68	4.93	5.24
	(2.19)	(2.26)	(1.89)	(2.17)	(2.28)	(2.19)
Pasta and cereals	5.45	5.29	5.26	5.40	5.58	5.75
	(2.78)	(2.72)	(2.66)	(2.84)	(2.78)	(2.87)
Fruit	2.67	2.64	2.58	2.57	2.66	2.92
	(1.34)	(1.46)	(1.22)	(1.20)	(1.23)	(1.58)
Vegetables	2.70	2.55	2.41	2.61	2.83	3.14
	(3.04)	(1.64)	(1.41)	(2.04)	(1.64)	(6.18)
Fats and oils	4.22	3.97	4.05	4.07	4.48	4.54
	(2.06)	(1.49)	(2.12)	(1.66)	(2.70)	(1.94)
Beverages	2.42	2.68	2.35	2.37	2.31	2.39
	(4.55)	(5.46)	(4.74)	(3.82)	(3.71)	(4.92)
Other food	7.08	6.90	6.49	6.88	7.27	7.92
	(5.00)	(6.08)	(4.68)	(4.26)	(4.63)	(5.12)
Budget shares						
Beef and veal	0.06	0.05	0.06	0.06	0.06	0.06
	(0.08)	(0.08)	(0.07)	(0.07)	(0.08)	(0.08)
Pork	0.02	0.02	0.02	0.02	0.02	0.02
	(0.05)	(0.05)	(0.05)	(0.05)	(0.04)	(0.04)
Chicken	0.04	0.03	0.04	0.03	0.04	0.04
	(0.06)	(0.06)	(0.06)	(0.05)	(0.06)	(0.06)
Turkey	0.01	0	0	0	0.01	0.01
	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)
Fish	0.03	0.02	0.02	0.03	0.03	0.03
	(0.05)	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)
Other meat	0.07	0.07	0.07	0.07	0.07	0.06
	(0.07)	(0.08)	(0.07)	(0.06)	(0.07)	(0.06)

Table 1: *(Continued)*

Variable	Aggregate Mean (SD)	Income Quintile 1 Mean (SD)	2 Mean (SD)	3 Mean (SD)	4 Mean (SD)	5 Mean (SD)
Milk	0.06	0.08	0.07	0.05	0.05	0.05
	(0.09)	(0.12)	(0.08)	(0.09)	(0.07)	(0.06)
Yogurt	0.01	0.01	0.01	0.01	0.01	0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Butter	0.01	0.01	0.01	0.01	0.01	0.01
	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)
Cheese	0.05	0.04	0.04	0.05	0.05	0.06
	(0.05)	(0.05)	(0.06)	(0.05)	(0.05)	(0.06)
Ice cream	0.01	0.01	0.01	0.01	0.01	0.01
	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)	(0.02)
Eggs	0.01	0.01	0.01	0.01	0.01	0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Bakery	0.10	0.11	0.10	0.10	0.10	0.10
	(0.08)	(0.10)	(0.08)	(0.06)	(0.08)	(0.07)
Pasta and cereals	0.05	0.05	0.06	0.05	0.05	0.05
	(0.05)	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)
Fruit	0.08	0.08	0.08	0.08	0.08	0.09
	(0.08)	(0.09)	(0.07)	(0.08)	(0.07)	(0.07)
Vegetables	0.10	0.10	0.09	0.10	0.10	0.11
	(0.08)	(0.09)	(0.07)	(0.07)	(0.07)	(0.08)
Fats and oils	0.01	0.02	0.01	0.01	0.01	0.01
	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)
Beverages	0.10	0.10	0.09	0.09	0.10	0.09
	(0.09)	(0.10)	(0.08)	(0.08)	(0.10)	(0.08)
Other food	0.19	0.19	0.19	0.19	0.19	0.19
	(0.12)	(0.13)	(0.11)	(0.12)	(0.11)	(0.10)
Households with children	0.29	0.29	0.39	0.27	0.23	0.27
	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)
Observations	4,976	998	982	1,008	1,100	888

Source: Statistics Canada 2001.

are even smaller: less than 1 percent for dairy and less than 2 percent for poultry (US Department of Agriculture n.d.). Canada's small export market share may be, in part, an artifact of supply controls imposed on production by Canadian marketing boards; it is possible that these market shares could increase if production quotas were removed and domestic output increased (Carter and Steinbach 2013). However, even if Canadian producers were able to compete at world prices and export SM commodities, it is unlikely Canadian producers' export market shares would be sufficiently high to affect world prices. The removal of import tariffs would increase competition for Canadian dairy and poultry producers and lead to significant structural changes to the production and processing stages of these supply chains in Canada. However, these structural adjustments would be in response to perfectly elastic demand for Canadian exports.

In light of Canada's status as a price taker in international dairy and poultry markets, we construct our counterfactual scenario through a series of cross-border price comparisons between Canada and the United States. Two points are worth noting about such comparisons. First, regional prices for dairy and poultry products vary within Canada and the United States; a comparison of national average prices may not be representative of the prices that Canadian consumers would face without SM. We account for these differences by calculating average retail prices for SM products in Canadian cities that are in close proximity to US markets.[6] Second, US prices for dairy and poultry products do not necessarily reflect competitive-market prices because these markets are distorted by US policy interventions (e.g., Chouinard et al. 2010). This consideration is not germane to our analysis, however, because US farm policies are unlikely to be swayed by changes in the Canadian policy landscape. Prices for dairy and poultry prices in the United

Table 2: Canada-US Retail Price Comparisons

	Border Price Comparison									
	2009		2010		2011		Average			Alternate Scenario
	Canada	US	Canada	US	Canada	US	Canada	US	Premium (%)	Premium (%)
Milk (whole), $/4 litres	5.02	3.87	5.14	3.80	5.48	4.01	5.21	3.89	34	47
Butter, $/kg	4.34	3.24	4.25	3.22	4.34	3.56	4.31	3.34	29	62
Yogurt, $/500 grams	2.06	1.68	2.20	1.52	2.36	1.53	2.20	1.58	40	22
Cheese (processed), $/250 grams	2.85	1.95	2.74	1.90	2.80	2.11	2.80	1.99	41	47
Ice cream, $/2 litres	5.13	4.70	5.29	4.46	5.38	4.74	5.27	4.63	14	22
Chicken (weighted aggregate), $/kg	7.35	5.47	7.49	4.83	7.58	4.72	7.47	5.01	49	26
Chicken (leg), $/kg	3.52	3.44	3.50	3.10	3.65	3.12	3.55	3.22	10	—
Chicken (breast), $/kg	11.63	8.35	11.84	7.45	11.75	7.18	11.74	7.66	53	—
Chicken (whole fresh), $/kg	5.05	3.48	5.21	2.93	5.51	2.92	5.26	3.11	69	—
Turkey (whole frozen), $/kg	3.29	2.99	3.46	2.81	3.33	2.97	3.36	2.92	15	26
Eggs (large), $/dozen	2.32	1.53	2.34	1.43	2.52	1.47	2.39	1.48	62	26

Note: Prices converted to Canadian dollars.
Sources: Authors' calculations from Agriculture and Agri-Food Canada n.d., Statistics Canada 2011, Bureau of Labor Statistics n.d., OECD 2004, Huff, Meilke, and Amedei 2000.

States under current US policies would be relevant to Canadian consumers if SM protections were removed.[7]

Table 2 contains the price comparisons used in our welfare analysis. Canadian dairy prices are taken from AAFC-CDIC's survey of retail prices in Canadian cities. We use average prices from Vancouver, Winnipeg, Windsor, and Montreal (all within 100 km of the US border) to generate comparison prices in locations where the difference in transportation costs between Canadian and US markets should not be significant. Note that prices in these cities are generally lower than prices in other Canadian cities in the same regions (e.g., Winnipeg vs. Regina/Calgary, Windsor vs. Toronto, Montreal vs. Quebec City), so the values in Table 2 can be interpreted as lower bounds for current Canadian prices by region. Prices for US dairy products are taken from the Bureau of Labor Statistics's (n.d.) Midwest retail price survey.[8] Prices for US products are converted to equivalent volumes and to Canadian dollars using average annual exchange rates. The price for chicken (weighted aggregate) is a weighted average generated from retail-level consumption expenditure shares of different chicken cuts (33 percent whole chickens, 41 percent breasts, 26 percent legs; Chicken Farmers of Canada 2013).

Columns 2 through 7 of Table 2 report retail prices from 2009 to 2011 in Canada and the United States. We use the average prices over this period (Columns 8 and 9) to generate the cross-border price comparisons in Column 10. These premiums form the baseline counterfactual price scenario for our simulation in which Canada's SM policies are dismantled and Canadian consumers can buy dairy and poultry products at prices equal to average retail prices in the Midwest US states. There is a wide range of price differences across commodities, from 14 percent for ice cream to 62 percent for eggs. The unweighted average premium is 38 percent.

Note that market concentration in the processing and retailing stages of the supply chain can also influence retail prices for SM products (Gervais and Devadoss 2006), and it is unclear how a liberalized SM industry would affect this. However, market power in the processing and retailing stages has been shown to increase dairy prices in the United States (Carman and Sexton 2005; Chidmi, Lopez, and Cotterill 2005), so we view US prices as the best comparators for our purposes.

Alternate Scenario

We construct a set of alternate counterfactual prices based on two studies that examine the liberalization of Canada's dairy and poultry markets. We use the results from OECD (2004) in which the AgLink global dynamic partial equilibrium model is used to estimate the market effects of complete liberalization in Canada's dairy market.[9] Huff, Meilke, and Amedei (2000) model the effects of increased market access on Canada's poultry market, including a scenario of complete liberalization. These studies predict lower prices and higher consumption following liberalization. The price premiums associated with the current SM system, based on these studies, are presented in the final column of Table 2. Note that this alternate scenario provides aggregated estimates of price premiums for milk and cheese, yogurt and ice cream, and the three poultry products. The estimated price premiums range from 22 percent for ice cream and yogurt to 62 percent for butter. The unweighted average premium across the four aggregated commodity groups

is 39 percent, which is very close to the unweighted average premium of 38 percent estimated in our cross-border price comparison.

Results

Table 3 presents compensated price elasticities of demand from the EASI model applied to the aggregated sample and to the sample disaggregated by income quintile. This discussion focuses on elasticity estimates for the SM commodities, but elasticities for all goods are provided. The price elasticities tend to be lower for higher-income households, with the differences between the lowest and highest income quintiles being particularly large for butter, cheese, and eggs. Price elasticities for the lowest-income-quintile households are above 1 for all SM products aside from milk and eggs; low-income households are sensitive to price changes for SM products. With the exception of turkey, price elasticities for households in the highest income quintile are below 1, which suggests these households are relatively insensitive to price changes of SM commodities. The elasticities reported in Table 3 are within the ranges of other food demand studies (e.g., Andreyeva et al. [2010] and Okrent and Alston [2011] provide surveys of previous food demand elasticities in the United States), with the exceptions of yogurt and cheese. Most of our estimated elasticities for SM products are larger than those found in other studies of Canadian food demand (e.g., Hassan and Johnson 1976; Pomboza and Mbaga 2007).[10]

Parameter estimates from the demand model are used to calculate compensating variations (CVs) across the income spectrum of households in our survey. CV can be understood as the negative of the amount that a consumer would accept in order to return to his initial level of utility after a change in price. We simulate a market in which prices for SM products are lower after liberalization; consumers therefore require negative compensation (i.e., a tax) in a liberalized market to attain the utility level that is achieved under SM. The CV is calculated as the difference between two cost functions:

$$\mathrm{CV} = C(p_0, u_0) - C(p_1, u_0), \tag{1}$$

where p_0 is the currently observed price vector with SM policies in place, u_0 is the utility level with SM, and p_1 is the counterfactual price vector in a liberalized market. As our comparison price scenario has lower dairy and poultry prices without SM policies, the expenditures required to attain u_0 under SM (at prices p_0) will be higher than in a liberalized market (at prices p_1), so this difference will be greater than zero. Note that the CV is smaller than consumer-surplus and equivalent-variation measures of consumer welfare changes in cases of price decreases, so our measure of the implicit tax imposed by SM is conservative.

Table 4 presents the welfare results aggregated for all SM commodities. Column 2 presents the estimates for the aggregated sample, and Columns 3 through 7 disaggregate the results by income quintile. We explain the welfare results through an example. Column 3 reports that households with children in the lowest income quintile would be indifferent between two options: (a) receipt of a transfer of $466 per year in the current SM regime and (b) a liberalized market for dairy and poultry products with no transfer. Put another way, the current SM system imposes a financial burden of $466 per year on Canada's poorest households with children. CVs increase with income and are higher for households with children. The average burden across all households is $444 per year: $585 for households with children and $378 for households without children.[11] Households with children shoulder larger burdens because their expenditures on SM products are higher than those of households with no children. Households with children spend approximately $1,211 per year on SM products compared to $774 for households without children.

We employ a simple concept of regressivity in our analysis of the distributional effects of SM policies. Specifically, we compare ratios of SM-imposed burdens to household incomes across the income spectrum. These ratios should increase with income under progressive policies and decrease with income under regressive policies; that is, progressive policies impose larger relative burdens on high-income households, while regressive policies impose larger relative burdens on low-income households. The incidences for Canadian SM range from 2.29 for the poorest households to 0.47 for the richest households and decrease monotonically as income increases. The poorest households incur a burden relative to income that is approximately five times larger than that of the richest households. This magnitude of difference between the incidence on the poorest households and the richest households is large in comparison to the distributional effects of other policies (e.g., carbon taxes in Hamilton and Cameron 1994), suggesting large regressive effects of Canada's SM policies.[12] The incidence of the SM-related burden is smaller for households with children (because average income is higher in these households), but the regressive pattern is consistent with the aggregate estimates.

Column 8 of Table 4 presents the welfare calculations using our alternate price scenario. The aggregate burden on consumers is smaller in this simulation; this is attributed to higher post-liberalization chicken prices in Huff et al. (2000). The pattern of regressivity is similar to the cross-border price comparison in this alternate scenario, however, with the lowest-income households bearing a relative burden (CV divided by income) that is more than five times larger than that of the highest-income

Table 3: Hicksian Own-Price Elasticities

		Income Quintile				
	Aggregate	1	2	3	4	5
Beef and veal	−0.831	−1.360	−0.875	−0.839	−0.680	−0.241
	(0.044)	(0.128)	(0.101)	(0.106)	(0.102)	(0.112)
Pork	−0.832	−1.079	−0.923	−0.819	−0.845	−0.766
	(0.078)	(0.174)	(0.180)	(0.206)	(0.206)	(0.221)
Chicken	−1.082	−1.127	−1.171	−1.117	−0.850	−0.886
	(0.048)	(0.104)	(0.087)	(0.083)	(0.086)	(0.112)
Turkey	−1.289	−1.337	−1.304	−1.285	−1.172	−1.146
	(0.095)	(0.235)	(0.264)	(0.204)	(0.213)	(0.216)
Fish	−0.864	−1.629	−1.106	−0.922	−0.747	−0.476
	(0.077)	(0.195)	(0.173)	(0.158)	(0.131)	(0.139)
Other meat	−1.022	−1.041	−1.121	−0.943	−0.960	−0.798
	(0.041)	(0.082)	(0.073)	(0.077)	(0.084)	(0.085)
Milk	−0.737	−0.831	−0.812	−0.781	−0.686	−0.619
	(0.069)	(0.145)	(0.126)	(0.139)	(0.123)	(0.131)
Yogurt	−1.124	−1.449	−1.364	−1.402	−1.234	−0.908
	(0.110)	(0.261)	(0.264)	(0.210)	(0.224)	(0.215)
Butter	−0.903	−1.385	−1.294	−0.963	−0.881	−0.619
	(0.198)	(0.435)	(0.393)	(0.466)	(0.485)	(0.396)
Cheese	−0.750	−1.132	−0.822	−0.761	−0.731	−0.564
	(0.051)	(0.118)	(0.112)	(0.107)	(0.101)	(0.106)
Ice cream	−0.984	−1.228	−1.065	−0.996	−0.888	−0.855
	(0.096)	(0.148)	(0.145)	(0.137)	(0.126)	(0.148)
Eggs	−0.490	−0.911	−0.587	−0.512	−0.448	−0.433
	(0.138)	(0.288)	(0.222)	(0.233)	(0.262)	(0.305)
Bakery	−0.588	−0.708	−0.725	−0.576	−0.449	−0.551
	(0.028)	(0.058)	(0.054)	(0.048)	(0.051)	(0.062)
Pasta and cereals	−1.022	−1.242	−1.086	−0.974	−0.899	−0.831
	(0.027)	(0.063)	(0.049)	(0.051)	(0.058)	(0.060)
Fruit	−0.602	−0.718	−0.638	−0.374	−0.432	−0.646
	(0.028)	(0.068)	(0.068)	(0.060)	(0.064)	(0.062)
Vegetables	−0.878	−0.936	−0.864	−0.958	−0.853	−0.858
	(0.026)	(0.056)	(0.049)	(0.046)	(0.045)	(0.053)
Fats and oils	−0.625	−1.431	−0.958	−1.018	−0.750	−0.369
	(0.099)	(0.161)	(0.171)	(0.140)	(0.136)	(0.171)
Beverages	−0.993	−1.053	−1.020	−0.977	−1.069	−1.026
	(0.013)	(0.039)	(0.038)	(0.038)	(0.043)	(0.045)
Other food	−0.714	−0.714	−0.747	−0.691	−0.651	−0.728
	(0.019)	(0.033)	(0.035)	(0.034)	(0.034)	(0.037)

Source: Authors' calculations.

households.[13] The welfare results, and the pattern of regressivity, from the cross-border price comparison model are robust to this alternate price scenario.

Table 5 reports welfare results separately for each supply-managed commodity.[14] Chicken, cheese, and milk account for approximately three-quarters of the aggregate burden, reflecting both the large expenditure shares and the high price premiums for these commodities. Note that the average CV for milk in households with children is almost double the CV for milk in households with no children; high milk prices impose a relatively large burden on households with children.

Discussion

Canada's trading partners will continue to apply pressure for improved access to Canada's dairy and poultry markets. Such pressure has piqued the interest of the Canadian popular press, and talk of liberalization has provided fuel for critics of SM policies; this has generated discussion of the distributional welfare effects on consumers. We put flesh on the bones of these criticisms by quantifying the welfare effects of Canada's SM policies across the income spectrum.

Our results suggest that the poorest households are penalized approximately 2.29 percent of their incomes

Table 4: Consumer Welfare Effects of Supply Management Policies

	Border Price Comparison						Alternate Scenario
		Income Quintile					
	Aggregate	1	2	3	4	5	Aggregate
Compensating variation ($/year)	444	339	468	419	450	554	429
Children	585	466	592	571	602	712	571
No children	378	280	376	361	393	487	363
Average household income ($/year)	52,499	14,788	33,707	44,219	59,952	118,189	52,499
Children	62,067	19,448	41,423	59,520	74,464	140,637	62,067
No children	48,630	12,844	28,842	38,697	55,555	110,065	48,630
Burden (compensating variation as % of income)	0.84	2.29	1.39	0.95	0.75	0.47	0.82
Children	0.94	2.40	1.43	0.96	0.81	0.51	0.92
No children	0.78	2.18	1.30	0.93	0.71	0.44	0.75

Source: Authors' calculations.

Table 5: Aggregate Consumer Welfare Effects by Commodity

	Chicken	Turkey	Eggs	Milk	Cheese	Yogurt	Butter	Ice Cream and Frozen Yogurt
Compensating variation ($/year)	134	5	51	91	128	28	14	8
Children	175	6	63	135	163	38	16	10
No children	115	4	46	71	112	23	13	7

Source: Authors' calculations.

as a result of high prices for dairy and poultry products, while the highest-income households are penalized approximately 0.47 percent of their incomes. The relative burden as a share of income is approximately five times larger for the poorest families relative to the richest families. When averaged across all income quintiles, the absolute burden is larger for households with children. In absolute terms, Canada's supply-managed system imposes an implicit tax on the poorest households with children that ranges from $466 to $592 per year.

High prices for SM products may indicate that consumers' (particularly low-income consumers') interests are not being considered in the determination of the policies that govern Canada's SM industries. Busby and Schwanen (2013) have suggested that such interests should be made part of policy decisions by adding new members who represent the interests of consumers to the Canadian Dairy Commission.

Our estimates of the overall effect of SM on Canadian households should be viewed as conservative. We take care to construct conservative measures of the impact of SM on dairy and poultry products. The use of CVs provides us with lower-bound estimates of the welfare impacts of SM, compared to equivalent-variation or consumer-surplus measures. Also, the available data restrict our analysis to food consumed at home. We therefore do not capture the welfare impacts of SM on food consumed at restaurants. Finally, our counterfactual price scenario is constructed using lower-bound prices for Canada and upper-bound prices for the United States, so our estimated price premiums are conservative. While we do not expect these factors to have substantial impacts on our measures of regressivity (i.e., the relationship between burdens at the high and low ends of the income spectrum), it does imply that our calculations of the absolute burdens imposed on Canadian consumers are lower-bound estimates.

The pursuit of new international trade agreements will continue to generate pressure to reduce the import taxes that insulate Canada's dairy and poultry markets from international competition. Such pressure will fuel discussions about the rent-seeking (loss of producers' quota value) and political economy (re-election) interests that have prevented significant liberalization. Our results highlight another important factor that should be prominent in policy decisions that will affect the future of Canada's dairy and poultry markets. The current SM system imposes large financial burdens on Canadian consumers, and these burdens are regressively distributed along the income spectrum.

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Notes

1 There are approximately 7,000 dairy-producing households and 1,600 poultry- and egg-producing households in Canada (Statistics Canada, 2011).

2 We include only a brief overview of the operation and regulation of SM industries. See Rude and An (2013) and Pouliot and Larue (2011) for more thorough treatments of quota determination and pricing in dairy and poultry markets.

3 The Comprehensive Economic and Trade Agreement will allow an additional 16,000 tonnes of cheese to enter Canada under the over-quota tariff rate (Canadian Broadcasting Corporation 2013); this amounts to approximately 4 percent of Canada's annual cheese consumption (Agriculture and Agri-Food Canada 2013). Cheese production uses approximately one-third of the butterfat and protein generated by Canadian dairy producers (Canadian Dairy Information Centre 2014), so we do not expect this change to affect the current market structure.

4 Summary statistics for the large number of remaining variables are available upon request.

5 It is likely that public funds would be used to compensate SM producers if current protections were removed (see Barichello et al. 2009 and Schmitz and Schmitz 2010 for a discussion of alternative methods to compensate producers). Our welfare estimates do not consider the burden on consumers of using public funds for this purpose.

6 Canadian poultry prices are not available by city, so national averages are used.

7 The removal of border measures may generate imports into Canada from other trading partners, particularly for processed and frozen products (e.g., cheese from the European Union and chicken from Brazil). The import prices for such products are likely to be near prices in the United States for similar products.

8 The Midwest region is used because two of the cities (Winnipeg and Windsor) in which we observe Canadian prices are in close proximity to Midwest US states. Vancouver is closest to the West region; however, the West region of the Bureau of Labor Statistics price survey includes Alaska, Hawaii, and California, and prices in those states are not representative of what Canadian consumers would face in a liberalized market. Montreal is closest to the Northeast region; however, we use the Midwest prices because average prices for dairy and poultry over our sample are higher in the Midwest than in the Northeast. This means that we use upper bounds for US price comparisons, so our simulated price premiums are conservative.

9 There is a thread of literature that simulates the market effects of partial liberalization of Canada's SM industries (e.g., Rude and An 2013). The results from these models are of limited use in our analysis because they consider partial liberalization in which the trade barriers that protect Canada's SM producers remain largely intact. We require scenarios of complete liberalization, which would generate much more significant restructuring than can be adequately modelled in a partial equilibrium model.

10 Note that our estimates are based on data collected under the current SM regime and that demand-function parameters could be sensitive to a significant reorganization of Canada's SM industries. For example, the SM boards currently invest in generic advertising, and it is possible that advertising expenditures would change if the current SM regime is removed. Any such changes should not significantly affect our regressivity measures, however.

11 We also calculate welfare effects under the assumption that the demand for each good is perfectly inelastic (fixed expenditure shares). Given our assumptions about the counterfactual price scenario, this provides a lower-bound estimate of the welfare effects because the quantity demanded would not increase in response to lower prices if demand was perfectly inelastic. We find that the aggregate burden on all households is $359, which is $85 less than our estimate presented in Table 4. Households with children incur a burden of $474 and households without children incur a burden of $305. The full set of results is available from the authors upon request.

12 Hamilton and Cameron (1994) report percentage changes in consumable income, by income quintile, resulting from the implementation of a carbon tax. We divide the burden for the lowest income quintile (CV relative to income) by the burden for the highest income quintile from our study and compare to equivalent measures (using percentage changes in consumable income instead of CV relative to income) used by Hamilton and Cameron (1994).

13 We do not report results by quintile for the alternate scenario. These results are available upon request.

14 These estimates are calculated separately for each commodity under the assumption that the prices of other supply-managed goods do not change. The aggregate welfare CV calculated in Table 4 allows the prices of all supply-managed goods to change simultaneously. This implies that the sum of the CVs for individual commodities in Table 5 ($459) is not the same as the aggregate CV reported in Table 4 ($444).

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Appendix

We use the Exact Affine Stone Index (EASI) demand model developed by Lewbel and Pendakur (2009). The EASI model offers two important advantages over alternative commonly used demand systems such as the Almost Ideal Demand System (AIDS) and the quadratic AIDS (QAIDS). First, in contrast to the AIDS and QAIDS models, the EASI model permits Engel curves (the relationship between income and budget shares) to take on arbitrary, non-linear shapes. This flexibility allows the Engel curves for each good to be different and, rather than restricting the parametric structure of Engel curves before estimation, lets the "data do the talking" (Pendakur 2009). Second, the error term in the EASI model captures unobserved consumer heterogeneity (i.e., consumer tastes), whereas the error term in the AIDS model does not have this interpretation (Lewbel and Pendakur 2009). The EASI model is therefore preferred in applications with household-level consumption data where a set of consumer characteristics is unobserved (Zhen et al. 2014).

We account for two issues commonly encountered when using cross-sectional data to estimate price elasticities of demand: (1) endogenous unit values that reflect quality differences among regions and, in our case, across income quintiles; and (2) selection bias resulting from zero expenditure within disaggregated food categories (see Okrent and Alston 2011 for a discussion of these issues). The first issue is addressed using quality-adjusted prices following Cox and Wohlgenant (1986). In this approach, the demographic characteristics of households are regressed on unit values. The quality-adjusted price is the summation of the intercept and error terms from this regression. The selection bias issue is addressed following the two-step procedure developed by Shonkwiler and Yen (1999). In the first step we estimate the likelihood that a household purchases the food item, and in the second step we estimate the parameters of the EASI budget share equations, adjusted for censoring.

In the first step, the decision to purchase food item i by household h is given by

$$d_{ih} = \begin{cases} 1 & \text{if } \mathrm{g}'_{ih}\tau_i + v_{ih} > 0 \\ 0 & \text{if } \mathrm{g}'_{ih}\tau_i + v_{ih} \leq 0 \end{cases} \quad \text{(A.1)},$$

for $i = 1, \ldots, N$ food categories and $h = 1, \ldots, H$ households. In Equation (A.1), $d_{ih} = 1$ if the household purchases the item and $d_{ih} = 0$ if the household does not purchase the item; g'_{ih} is a vector of exogenous variables that influence purchase choices; τ_i is the related vector of parameters; and v_{ih} is an error term. The vector of parameters τ_i is estimated by a binary probit model and used to obtain the estimated cumulative distribution function $\hat{\Phi}(\mathrm{g}'_{ih}\tau_i)$ and probability density function $\hat{\phi}(\mathrm{g}'_{ih}\tau_i)$.

For the second step we specify latent budget shares of the EASI model as follows:

$$w^*_{ih} = \sum_{k=1}^{N} \alpha_{ik} \ln p_{kh} + \sum_{r=0}^{R} \beta_{ir} y^r_h + \sum_{t=1}^{T} \gamma_{it} z_{th} + e_{ih} \quad \text{(A.2)},$$

$$y_h = \ln x_h - \sum_{i=1}^{N} \bar{w}_i \ln p_{ih} \quad \text{(A.3)}.$$

In Equation (A.2), w^*_{ih} is the latent budget share for food product i in household h; p_{kh} is the quality-adjusted price of food k for household h, $k = 1, \ldots, N$ food categories; the parameter α_{ik} describes price effects; y_h is the log of real expenditure on food at home for household h; $r = 0, \ldots, R$ is a polynomial that is determined empirically with the restriction $R < N$; the parameters β_{ir} describe the shape of the Engel curve; z_{th} is a vector of household characteristics indexed by the demographic variable t; and parameter γ_{it} describes demographic shifters in budget shares. Finally, the error term e_{ih} incorporates unobserved preference heterogeneity into budget shares. In Equation (A.3), x_h is total expenditure on the N food categories, and $\bar{w}_i$ is the sample average budget share of food item i over all households. The use of the sample average budget share implies that we estimate the approximate EASI model, as described by Lewbel and Pendakur (2009). Homogeneity of degree 1 in prices and expenditure, and Slutsky symmetry, is imposed in estimation.

As do Shonkwiler and Yen (1999), we assume that the error terms for each food item (v_{ih}, e_{ih}) follow a bivariate normal distribution with covariance parameter ψ_i, which is estimated in Equation (A.4) and captures the importance of censoring. The corresponding observed budget share equations used to estimate the parameters of the modified EASI model are given by

$$w_{ih} = \hat{\Phi}(\mathrm{g}'_{ih}\tau_i)\left(\sum_{k=1}^{N} \alpha_{ik} \ln p_{kh} + \sum_{r=0}^{R} \beta_{ir} y^r_h + \sum_{t=1}^{T} \gamma_{it} z_{th}\right) + \psi_i \hat{\phi}(\mathrm{g}'_{ih}\tau_i) + \eta_{ih} \quad \text{(A.4)},$$

where w_{ih} is the observed budget share and the error term is

$$\eta_{ih} = e_{ih} + [\Phi(\mathrm{g}'_{ih}\tau_i) - \hat{\Phi}(\mathrm{g}'_{ih}\tau_i)] \times \left(\sum_{k=1}^{N} \alpha_{ik} \ln p_{kh} + \sum_{r=0}^{R} \beta_{ir} y^r_h + \sum_{t=1}^{T} \gamma_{it} z_{th}\right) + \psi[\phi(\mathrm{g}'_{ih}\tau_i) - \hat{\phi}(\mathrm{g}'_{ih}\tau_i)].$$

Elasticities for the two-step estimation are derived from the censored demand equation (Yen, Kan, and Su 2002) and are calculated as

$$\varepsilon^h_{ij} = \frac{1}{\overline{w_i}} \hat{\Phi}_{\mathrm{i}} \alpha_{ij} + \overline{w_j} - \delta_{ij} \quad \text{(A.5)},$$

where ε^h_{ij} is the Hicksian elasticity of demand for good i with respect to price of good j. The parameter δ_{ij} is the Kronecker delta with $\delta_{ii} = 1$ for own-price elasticities and $\delta_{ij} = 0$ for cross-price elasticities. We use the sample mean of the cumulative density function as a measure of $\hat{\Phi}_{\mathrm{i}}$.