

Marginal Excess Burden and Industry Opposition to Unilateral Carbon Taxes: Evidence from Agriculture

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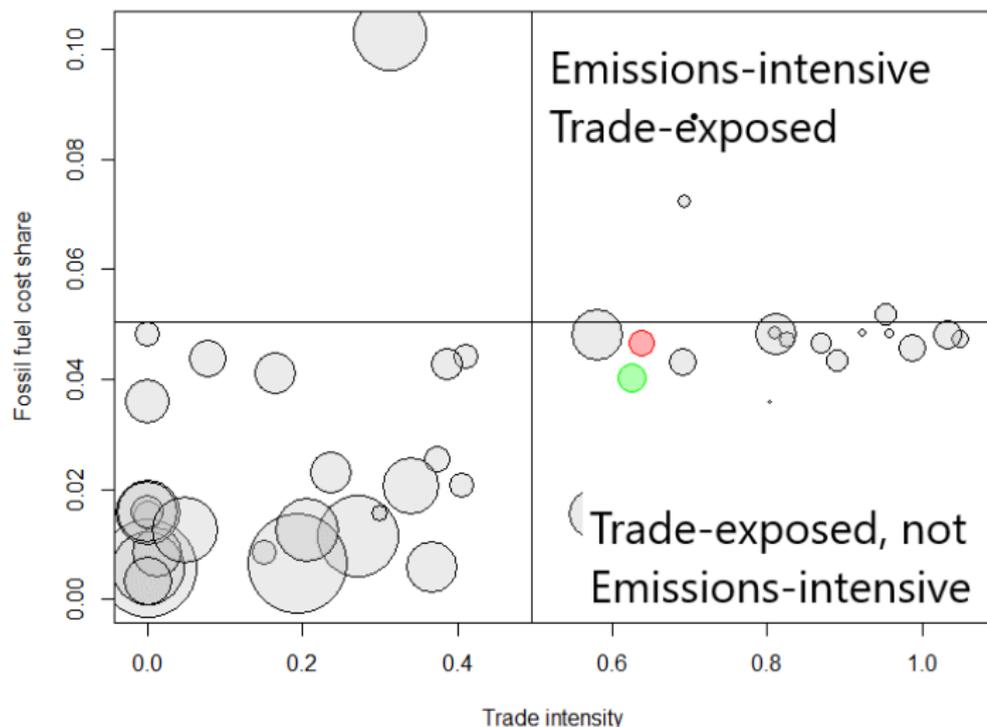
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Motivation

- ▶ Canada is implementing a national carbon price
 - ▶ Broad tax base and increasing stringency in terms of \$/CO₂e
 - ▶ Provinces are able to tailor details to specific economic conditions
 - ▶ *Unilaterally implemented* (vis-à-vis US)
- ▶ Industry opposition is from unusual sources
 - ▶ Agriculture is especially opposed to carbon taxes
 - ▶ This is odd...

Trade-exposed but not emissions-intensive



This paper

- ▶ Industry perspective on leakage
 - ▶ Gross of environmental benefits
- ▶ Measures the “competitiveness effects” of Canada’s carbon tax for beef cattle industry

Main result: *Policy stringency varies nonlinearly with demand shocks*

- ▶ Carbon taxes are *specific* taxes
- ▶ Stringency depends on how output elasticities and tax rates change with product prices
- ▶ Curvature of supply function determines stringency

Related literature

- ▶ **Trade and environment:** Copeland and Taylor (1994), Taylor and Levison (2008), Dechezleprêtre and Sato (2017), Cherniwichan and Najjar (2018)
- ▶ **Computable general equilibrium simulations:** Carbone and Rivers (2017), Böhinger, Carbone, Rutherford (2016), Babiker (2008)
- ▶ **Agriculture and climate policy:** Garnache, Merel, Lee and Six (2017), Slade (2018), De Cara, Henry and Jayet (2018)

Outline

1. Intuition for result
2. Marginal excess burden
 - ▶ Measure of competitiveness effect
3. Sketch of empirical approach and counterfactuals
4. Results
5. Extensions

Leakage

Three dimensions to leakage (Fowlie, Regaunt, Ryan, 2016):

1. Emissions leakage
2. Market transfers
3. Rent leakage

Leakage

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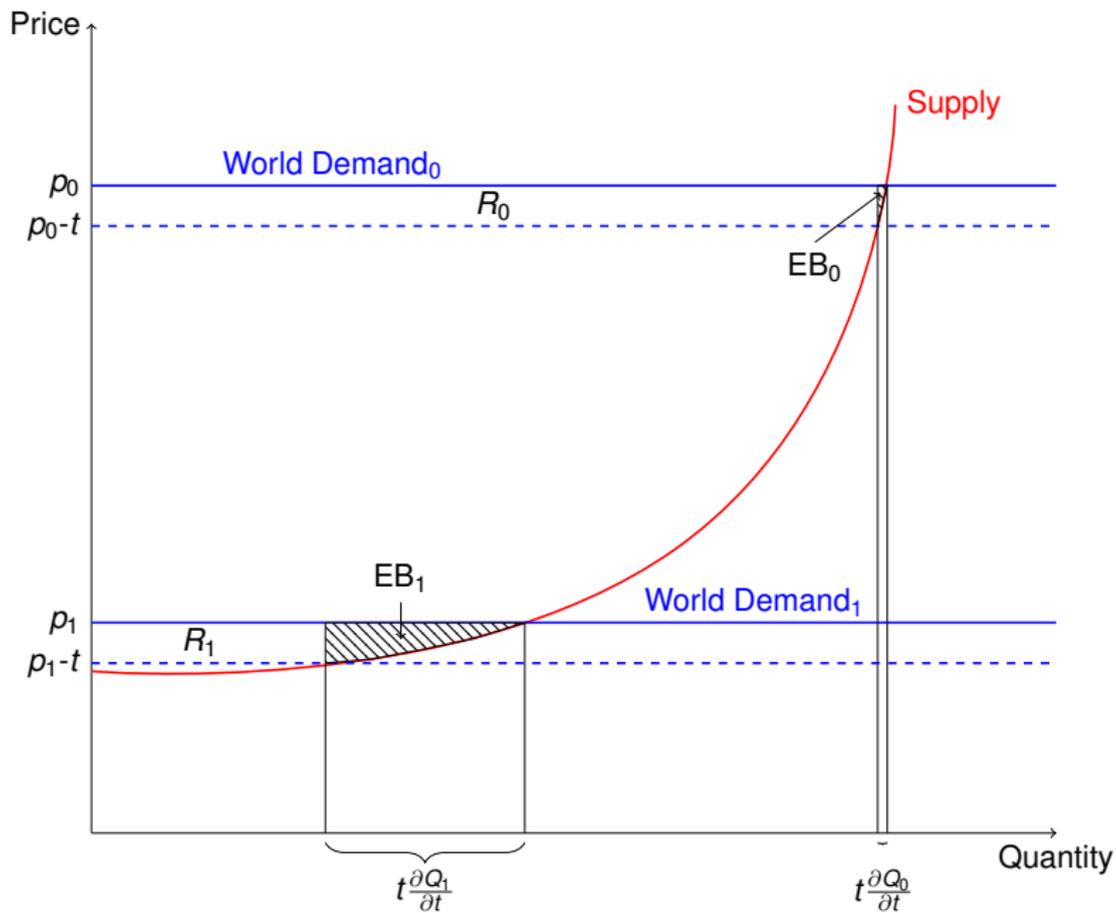
1. Emissions leakage
2. **Market transfers**
3. **Rent leakage**

Refresher on economics of taxation

Two basic principles underlie the efficiency cost of a commodity tax:

1. Excess burden increases with elasticities
2. Excess burden increases the square of the tax rate

Changes in excess burden – net of tax revenue changes – provide a money-valued measure of policy stringency.



Marginal excess burden

Measures the stringency of a carbon tax from a *producer* perspective

Marginal excess burden measures the change in excess burden relative to a change in tax revenues.

- ▶ Interpreted as the *stringency* or *competitiveness* effect of a given carbon tax
- ▶ Gross of environmental benefits

For a perfectly competitive agricultural industry, MEB is:

$$MEB = \frac{1}{1 - \frac{t}{p-t}\eta} - 1$$

- ▶ p is output price
- ▶ t is the *effective* carbon tax in \$/cwt
- ▶ η is the elasticity of supply

Constructing the marginal cost curve

De Loecker and Warzynski (2012, AER) and Ganapati et al. (2018, NBER) approach

Industry marginal costs are recovered as an ordered list of Lagrange multipliers.

- ▶ Estimated by combining farm-level data on prices and quantities with assumptions on cost minimization

Write the Lagrangean:

$$\mathcal{L}(V_{it}, K_{it}, \lambda_{it}) = P_{it}^V V_{it} + R_{it} K_{it} + \lambda_{it}(Q_{it} - Q_{it}(V_{it}, K_{it}, \Omega_{it}))$$

Differentiating and rewriting the first-order condition on variable inputs:

$$\frac{P_{it}}{\lambda_{it}} = \theta \left[\frac{P_{it}^V V_{it}}{P_{it} Q_{it}} \right]^{-1}$$

Estimating the output elasticity

Obtaining unbiased estimates of production parameters is challenging.

- ▶ Unobserved, farm-specific productivity implies simultaneity bias when estimating primitives based on observed inputs

Three methods:

- ▶ Pooled least squares
- ▶ Fixed effects
- ▶ Control function (Akerberg, Caves, Fraser, 2015, *Econometrica*)

	OLS	FE	ACF
Elasticity	0.173 (0.034)	0.092 (0.032)	0.159 (0.035)

Policy counterfactuals

Six scenarios considered

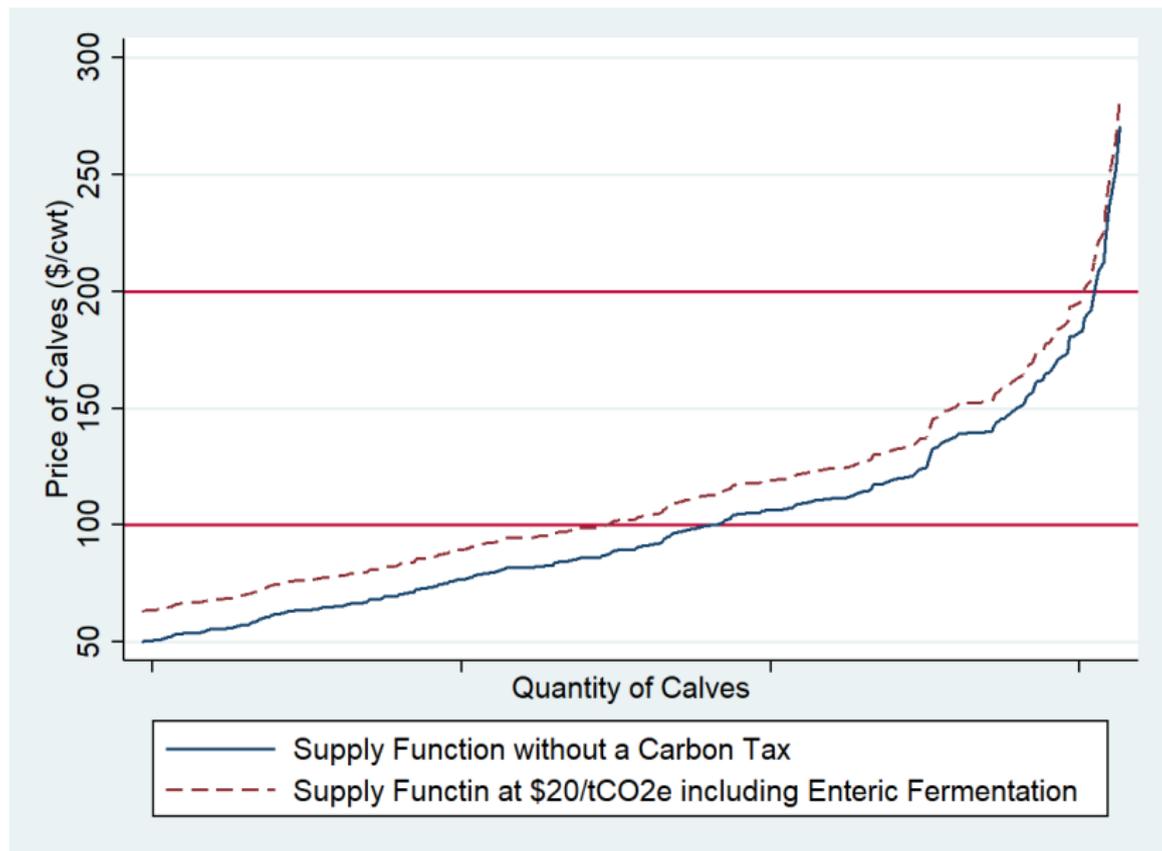
Effective carbon taxes in \$/cwt.

	<u>\$20/tCO₂e</u>	<u>\$40/tCO₂e</u>
Canadian backstop	1.55	1.87
+ Tax of farm fuel	1.91	2.58
+ Tax on enteric fermentation	12.80	24.35

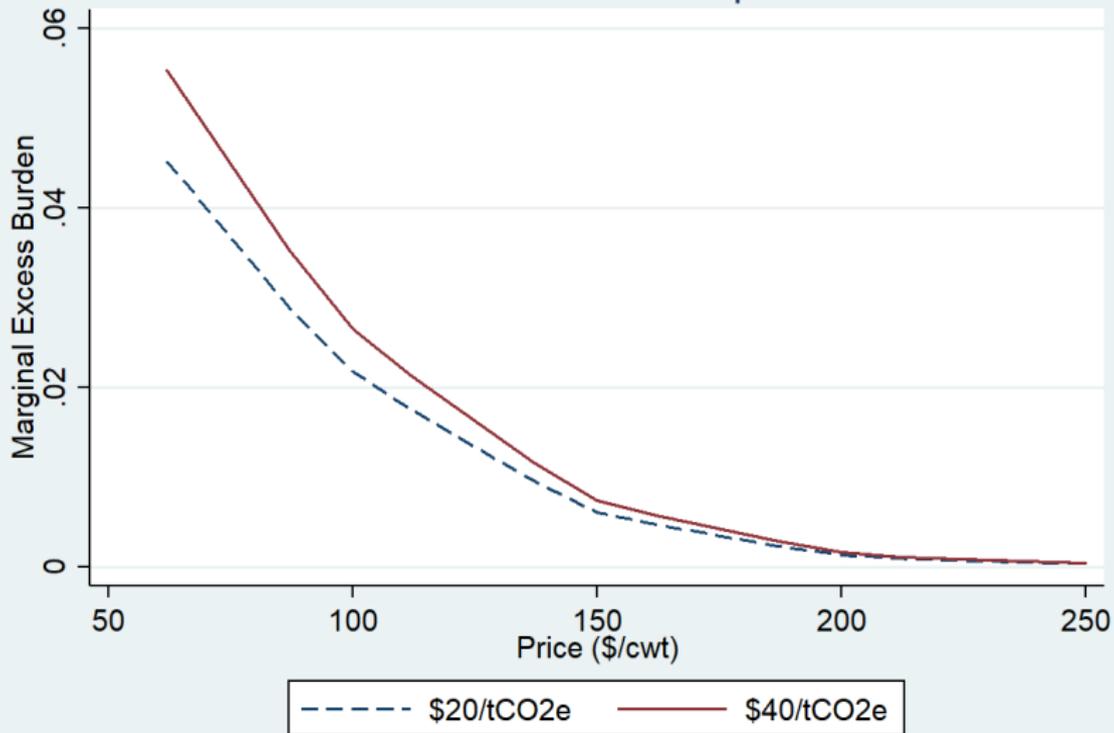
Estimates constructed by cobbling together different values from models and the literature (cash flow models, CGE estimates, structural model).

- ▶ Most uncertain component of empirical analysis

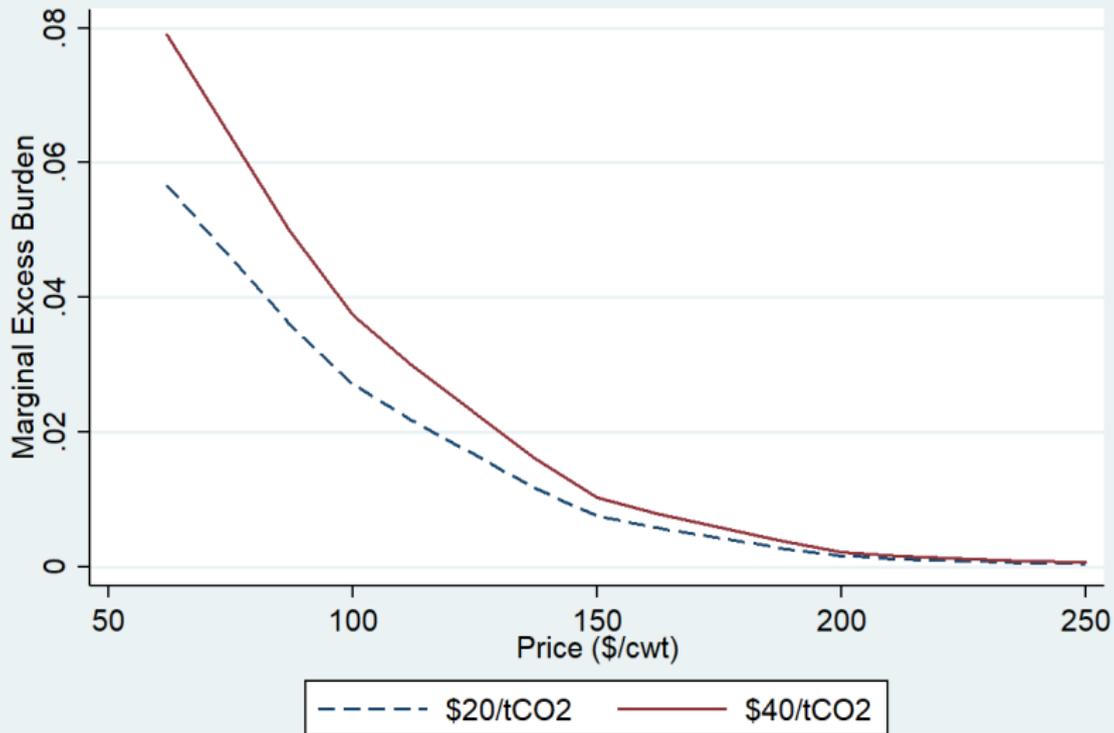
Supply curve plus \$20/tCO₂e tax incl. enteric fermentation



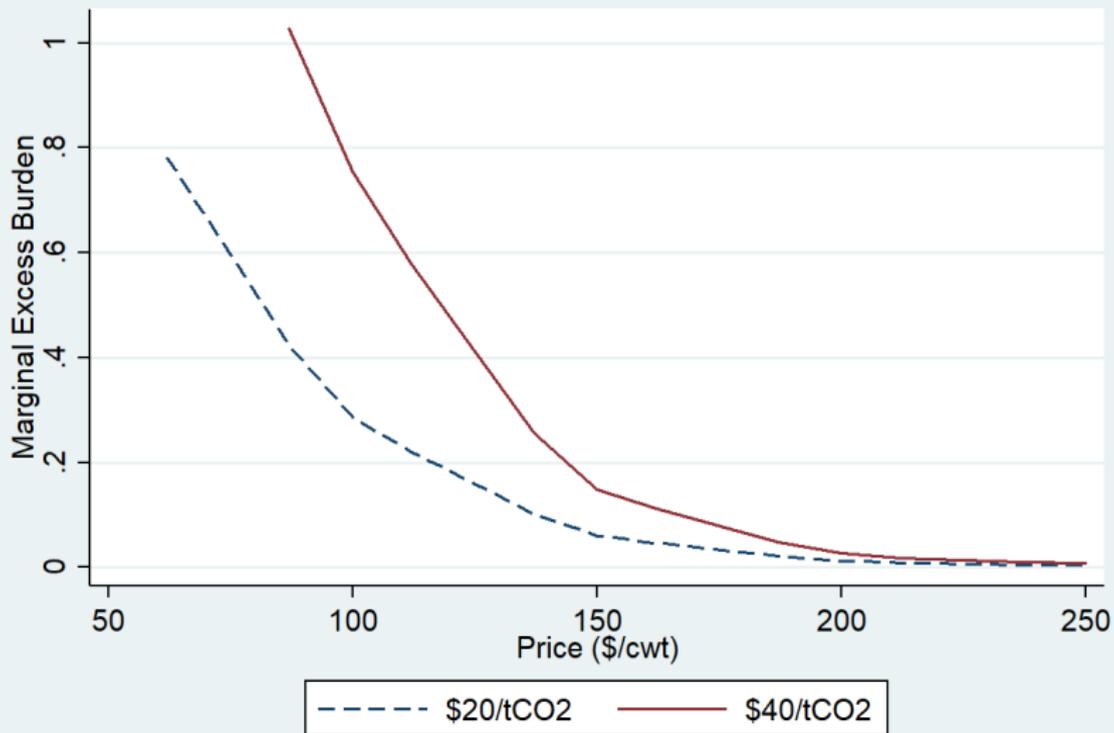
w/ Farm Fuel Exemption



Tax on Farm Fuel



w/ Tax on Enteric Fermentation

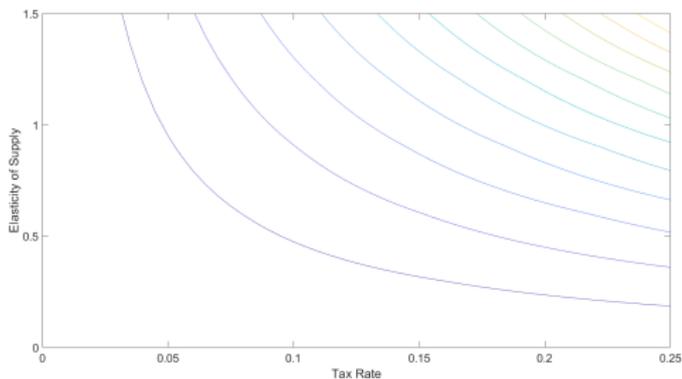
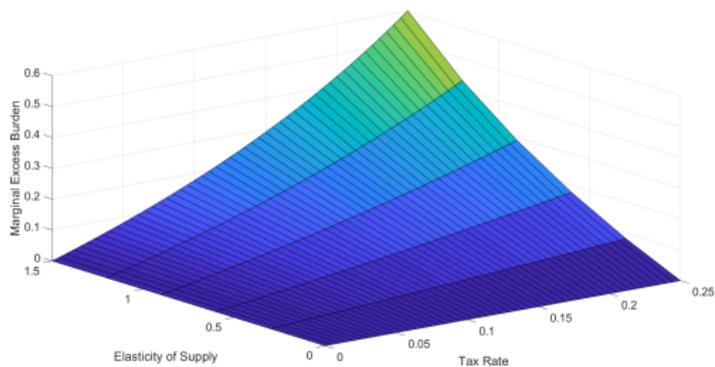


Marginal excess burdens at three benchmark prices

Unless biological emissions are covered, carbon taxes are not a major burden for beef farmers.

	<u>\$100/cwt</u>	<u>\$150/cwt</u>	<u>\$200/cwt</u>
		<i>\$20/tCO₂e</i>	
Backstop policy	0.02	0.01	0.00
+ Tax on farm fuel	0.03	0.01	0.00
+ Tax on enteric fermentation	0.28	0.08	0.01
		<i>\$40/tCO₂e</i>	
Backstop policy	0.03	0.01	0.00
+ Tax on farm fuel	0.04	0.01	0.00
+ Tax on enteric fermentation	0.90	0.17	0.03

Revisiting the efficiency cost of taxes



Summary

- ▶ Agriculture strongly opposes Canada's carbon tax
- ▶ Stringency of a fixed carbon tax varies with product prices
 - ▶ Measured as marginal excess burden
 - ▶ Change in stringency depends on the curvature of the supply curve
- ▶ Sample analogue of the MC curve can be constructed based on reasonable assumptions about farmer behaviour
 - ▶ Used for policy counterfactuals
- ▶ Nonlinear relationship between product prices and MEB
- ▶ Farmers have little to worry about from carbon pricing unless digestive (or soil) emissions are taxed

Thank you.
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