Carbon Tax Competitiveness Concerns: Assessing a Best Practices Income Tax Credit

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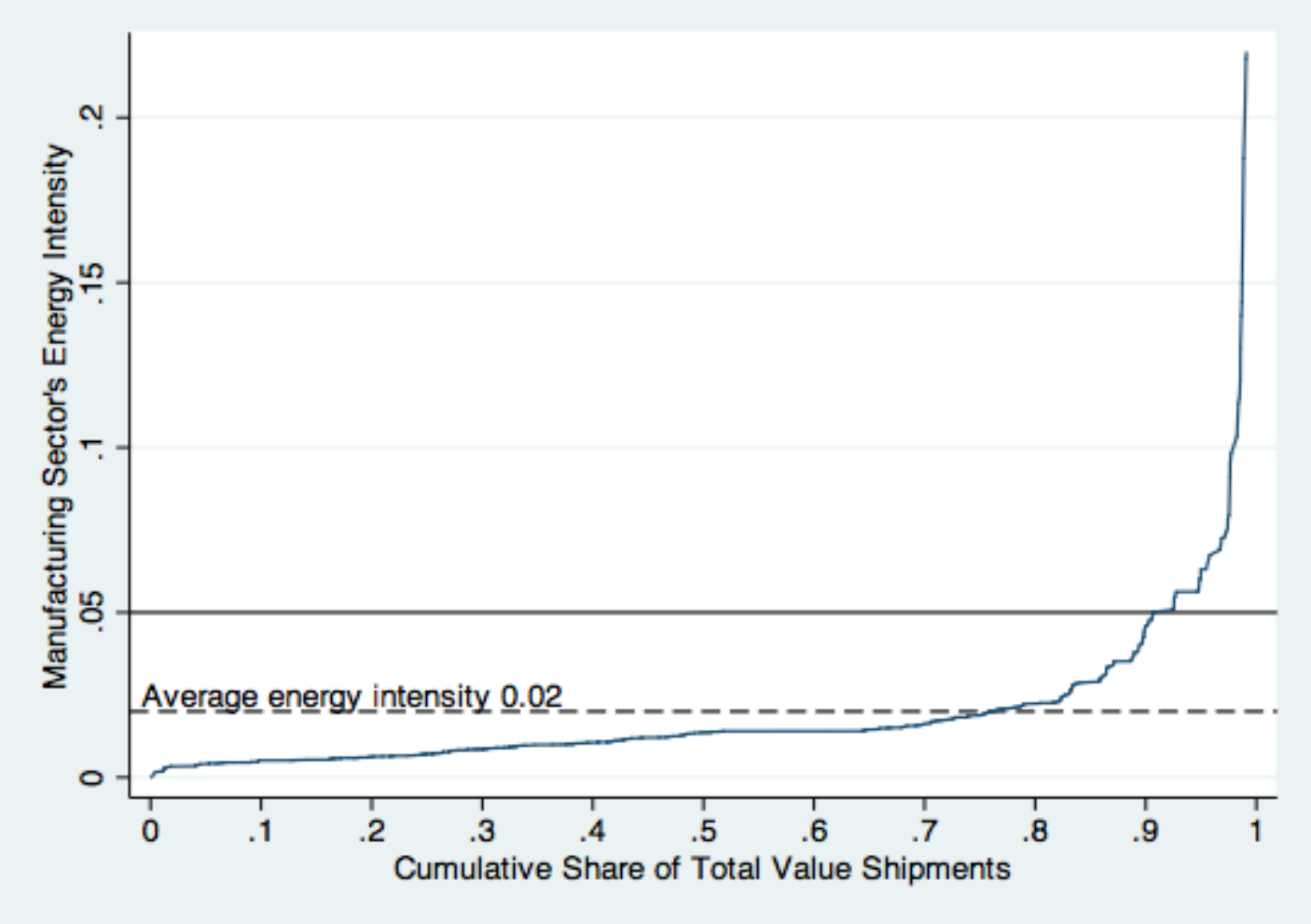
Energy Intensive Trade Exposed Sectors

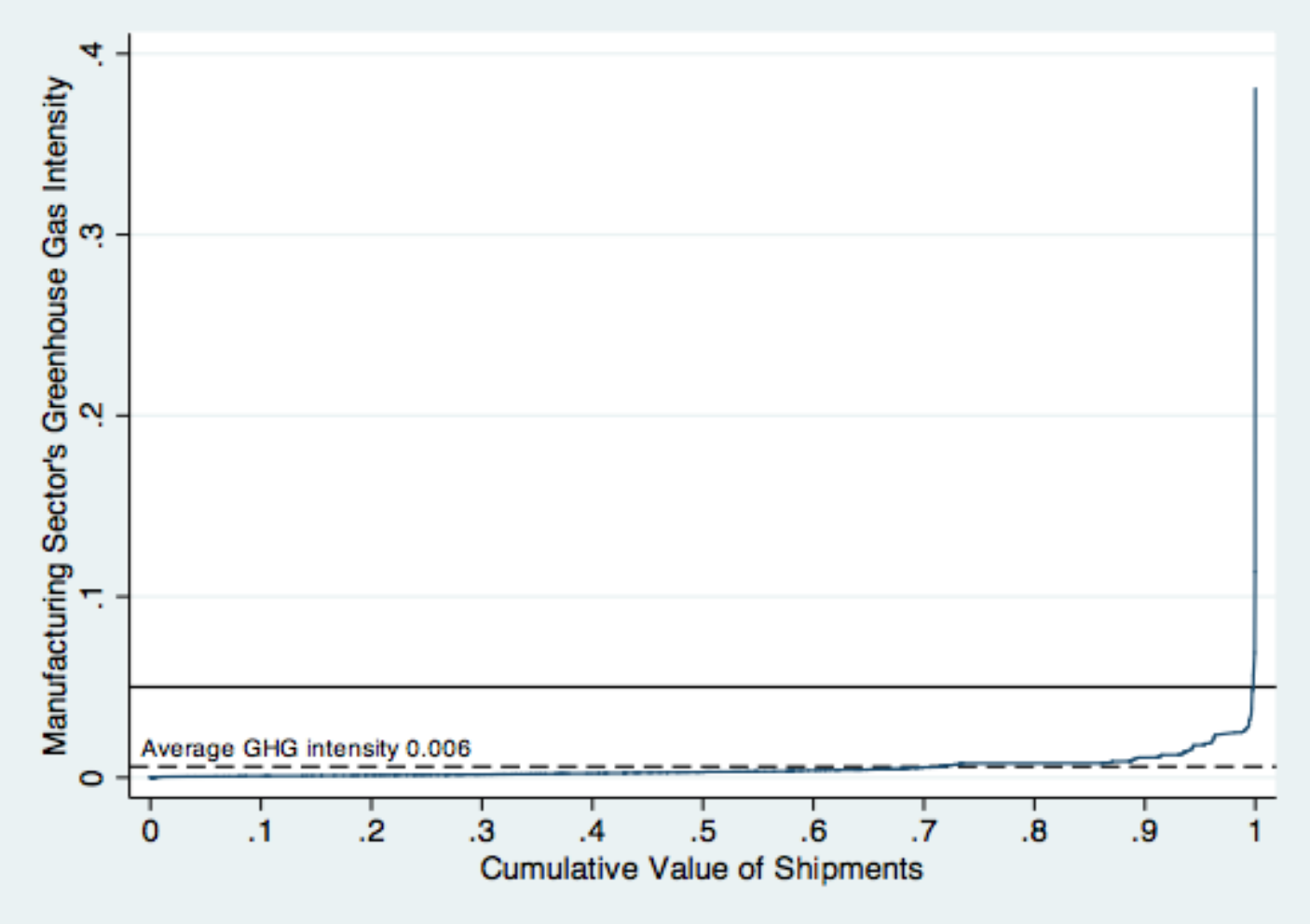
- EITE sectors a concern in negotiations leading to H.R. 2454
- EITE treatment under a carbon tax reform
  - Should there be special treatment for EITE sectors?
  - What are the options?
  - How should we assess these options?

Energy Intensity and the Value of Shipments



Metcalf (2014)

Greenhouse Gas Intensity and the Value of Shipments



Metcalf (2014)

Border Adjustments

- Two broad approaches to addressing concerns of EITE sectors
  - Border adjustments on certain traded goods (Kortum and Weisbach, 2016)
  - Tax credits for certain domestic firms (Gray and Metcalf, 2016)
- Legal issues floating in the background that could affect design considerations (Tractman, 2016)
- Larger economic and political question of whether we need to do anything (Aldy, 2016)

Focus of This Paper

- Output-based tax credits in the corporate income tax for carbon tax payments
  - Best-practices design
  - Limited ability to use credits
- Similar to benchmark allocation approach in Phase III of EU-ETS
  - Also Pezzey and Jotzo (2013) “free carbon” idea

Questions for Analysis

- How to structure tax relief for firms in EITE sectors using the income tax?
- Focusing on a best-practices output-based tax rebate,
  - How are firms differentially impacted within sectors?
  - Do firms have sufficient tax appetite to use tax credits in current year?

Research Approach

- Use Census establishment level data:
  - 2010 Manufacturing Energy Consumption Survey (MECS)
  - 2012 Census of Manufactures (CMF)
- Estimate carbon dioxide emissions and carbon tax liability at the establishment level
- Allocate corporate income tax liability to the establishment level

Findings of Paper

- The relatively few sectors with high total emissions also have high emissions rates
- There is considerable variation in emissions intensity within sectors (and variation across sectors in the shape of the intensity distribution)
- Emissions intensity is higher in pre-1976 plants, larger plants, and less productive plants
- Using sector-level income tax data, relatively few sectors are likely to have “unusable” carbon tax credits (exceeding their income tax liability)
  - But there is likely to be variation within sectors

(Selective) Previous Research

- Addressing Leakage Concerns with Cap and Trade Systems
  - Fischer and Fox (2007): OBA subsidizes production but requires higher MAC for given emission cap (2 distortions)
  - Monjon and Quirion (2011): focus on EU ETS comparing border adjustments with output-based allocations
- Consideration under a Carbon Tax
  - Fischer and Fox (2012): compare and contrast various leakage mechanisms including OB rebates
  - Metcalf (2014): focus on targeted relief comparing and contrasting various tax credits
- EMF29 (2012) modeling analysis of border carbon adjustments with unilateral carbon pricing policies focused on EITE sectors
  - Main focus on BCA; Leakage reduction on the order of 2-12 percent (8 percent on average across models)
  - Fischer and Fox (2012): compared BCA and OBR. Additional cost of OBR arises from tax interaction effects

EITE Eligibility for Tax Relief

- Follow approach of H.R. 2454
- Presumptive eligibility if one or more of the following hold:
  - Energy intensity is 5 percent or greater, and trade intensity is 15 percent or greater
  - GHG intensity is 5 percent or greater, and trade intensity is 15 percent or greater
  - Energy intensity is 20 percent or greater
  - GHG intensity is 20 percent or greater

Presumptive Eligibility for Tax Credit

- EPA (2009) found 44 manufacturing and 2 mineral processing sectors presumptively eligible (out of ~500 6 digit sectors)
  - Data from 2006, 2007
  - H.R. 2454 called for eligibility updating every four years
- Metcalf (2014) updated eligibility and found fewer eligible sectors
  - Risk of cycling in and out of eligibility with eligibility updating

Modeled Carbon Tax

- $20 per ton on energy-related emissions in 2012 modeled
- SR revenue estimate: ~$100 billion before tax offset
- EITE sector carbon tax revenue: $11.4 billion

Attributing Emissions to Plants

- 2012 CMF
  - Total expenditure on fuels
  - Electricity expenditure and quantity consumed
- 2010 MECS
  - Detailed fuels expenditure and quantity consumed
- 2012 emissions derived separately from
  - Electricity consumption
  - Fossil fuel use
  - Process emissions

Electricity Related Emissions

- Electricity related emissions available at the zip code level from EPA's Emissions & Generation Integrated Resource Database (eGRID)
- CO_2 emissions per MWh for each establishment generated based on zip code location of plant

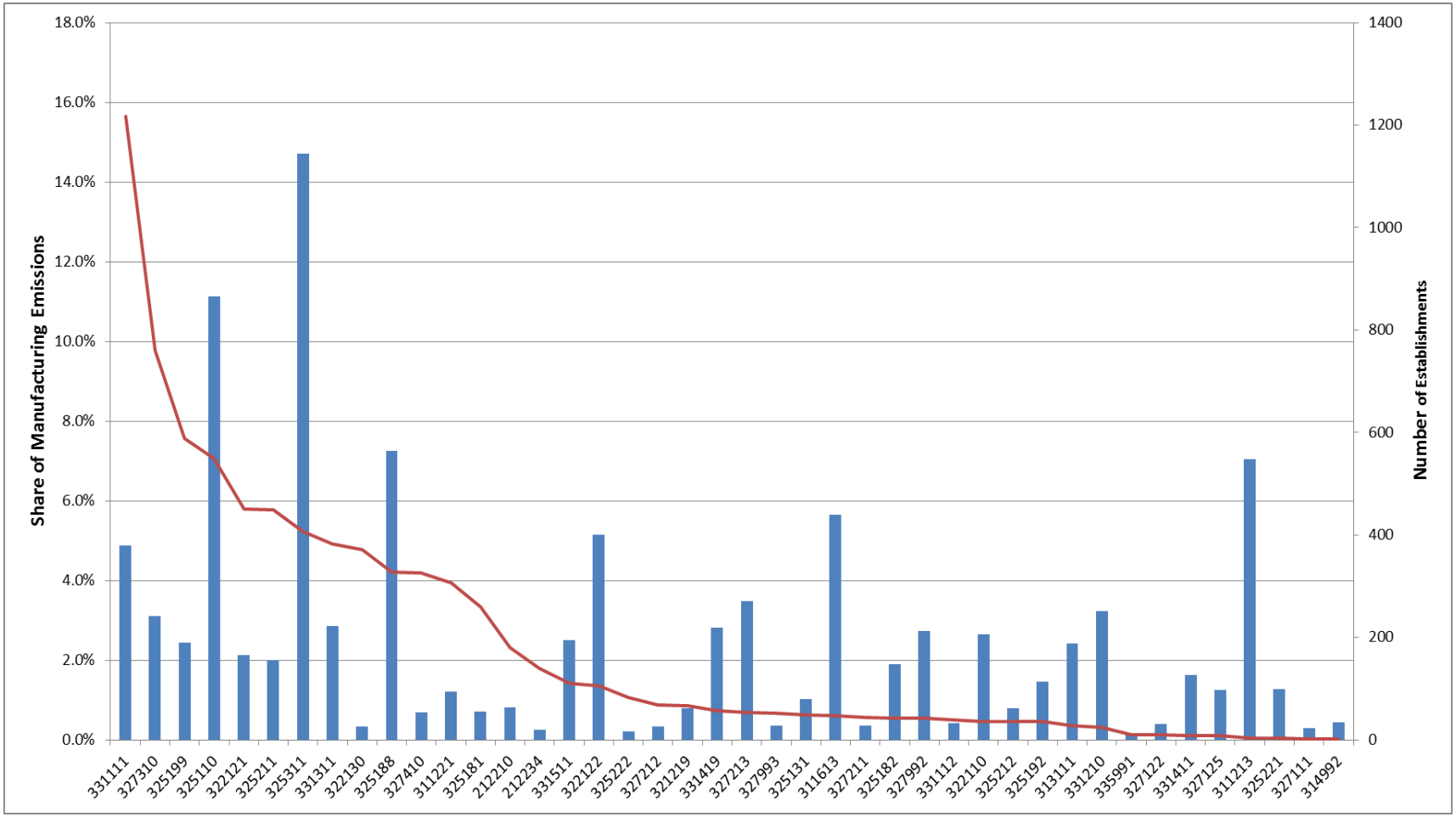
Fossil Fuel Consumption Related Emissions

- Using 2010 MECS data, construct expenditure shares for coal, natural gas, and petroleum conditional on sector, region, and plant age
- Allocate fuel expenditures in 2012 CMF based on fossil fuel expenditure shares from MECS
- Convert to quantities using EIA State Energy Data Systems (SEDS) prices for state-level industrial fuels
- Convert to emissions using EIA national average emission factors

Process Emissions

- For sectors with significant process emissions, we follow EPA's Emissions Inventory approach for relevant sectors
- In general, process emissions are a linear function of output.

Measuring Sector Variability



Sectors sorted by descending share of manufacturing emissions (higher emitters on the left); vertical bars show number of establishments per sector in the 2012 CMF data

Distribution of CO2 Emissions Intensity

NAICS	Industry	Emissions Share	Mean	SD	Skew	C.V.
331111	Iron+Steel	15.7%	943	1,547	6.4	1.6
327310	Cement	9.8%	16685	5,515	2.1	0.3
325311	Nitrogen Fertilizer	7.6%	8268	2,007	9.5	0.2
325199	Organic Chem	7.1%	808	1,037	6.0	1.3
322121	Paper	5.8%	1754	2,895	9.8	1.7
322130	Paperboard	5.8%	2085	1,205	1.1	0.6
325211	Plastics	5.2%	394	918	13.1	2.3
325193	Ethyl Alcohol	4.9%	1435	1,239	7.0	0.9
331312	Primary Aluminum	4.8%	6579	4,217	0.9	0.6
325188	Inorganic Chem	4.2%	1200	1,345	6.2	1.1

Understanding Variation in Emissions Intensities Within Sectors

Dependent Variable = log (CO_2 Intensity)

MODEL	1	2	3	4	5
Age	0.001 (0.001)			-0.004** (0.001)	-0.002 (0.002)
Pre-1976 dummy	0.247*** (0.036)			0.238*** (0.036)	0.211*** (0.035)
log(employees)		0.110*** (0.007)		0.105*** (0.008)	0.085*** (0.007)
log(productivity)			-0.081*** (0.013)	-0.098*** (0.013)	-0.116*** (0.013)
Sector	x	x	x	x	
Region	x	x	x	x	
Sector*Region					x
N			~7500		
R-squared	0.561	0.569	0.558	0.575	0.618

* = coefficient significant at 5% level

Output Based Credit

E_{ij} – emissions of plant *i* in sector *j*

C_{ij} – tax credit for plant *i* in sector *j*

Y_{ij} – value of shipments for plant *i* in sector *j*

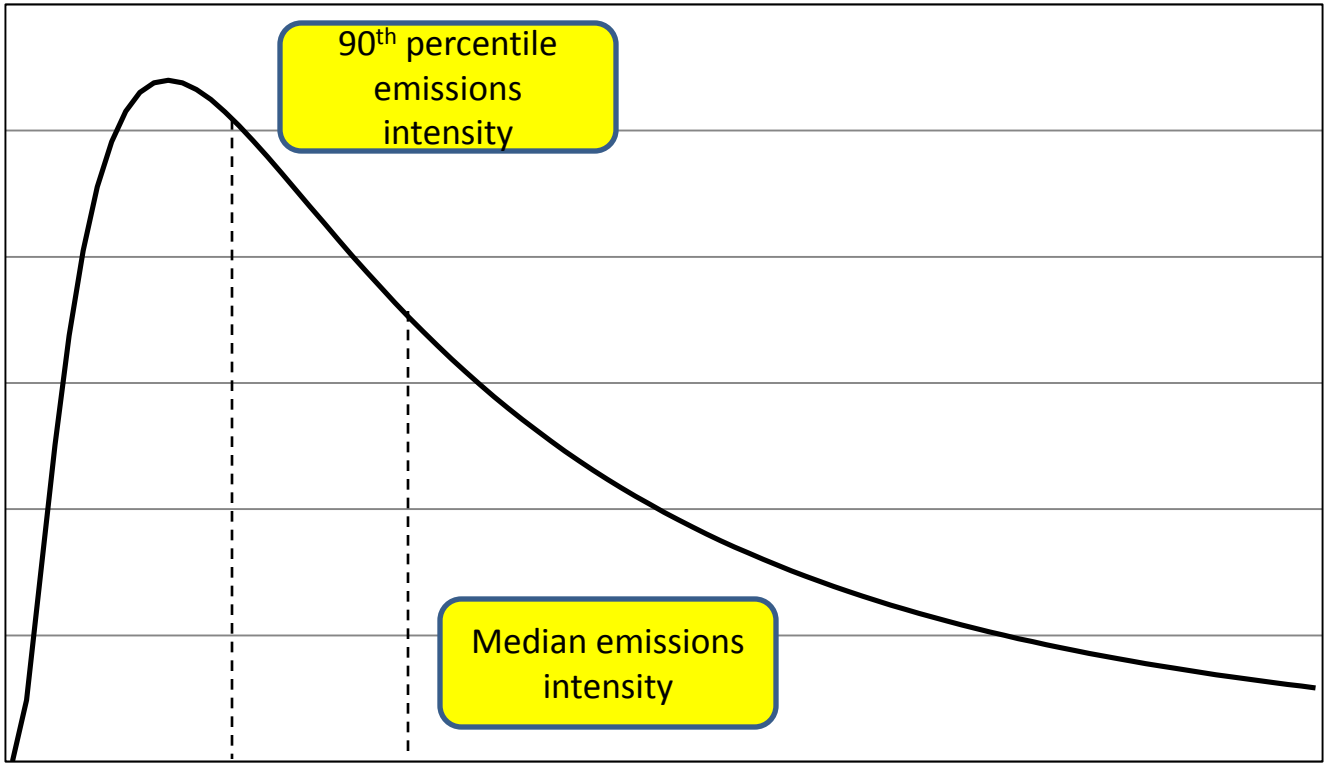
$\hat{\phi}_j^{\mu}$ - measure of emissions per value of shipments in sector *j*

τ – carbon tax rate

$$C_{ij} = \tau \hat{\phi}_j^{\mu} Y_{ij}$$

Credited Emissions	Non-Credited Emissions
$\hat{\phi}_j^{\mu} Y_{ij}$	$E_{ij} - \hat{\phi}_j^{\mu} Y_{ij}$

Crediting Base



Emissions Intensity $\left({}^{E_{ij}}/_{Y_{ij}}\right)$

$$C_{ij} = \tau \hat{\phi}_j^{\mu} Y_{ij}$$

Best Practices Credit

- An output based credit that addresses competitiveness issues
- Set appropriately, it minimizes tax appetite problems
- Incentivizes best practices and investments in new technologies to reduce emissions
- *But…* output based credits inefficient on the final demand margin

Design Attributes

- Credit is inframarginal
- Tied to firm output and so provides a price subsidy
- Policy decision to cap credit at carbon tax liability or not
  - Affects most efficient firms
- Best practices cut-off a policy choice
  - Implications for cost of credit

Plant Specific Tax Credit

- Construct distribution of emissions intensity (emissions to value of shipments ratio) for each sector;
- Measure emissions intensity of plant with "best practices" – emissions intensity below 95 percent of all other plants in sector $\left(\hat{\phi}_j^{\mu}\right)$
  - We vary cutoff percentile and consider unweighted distributions and distributions weighted by sales
- Plant *i* in sector *j* allowed an income tax credit equal to carbon tax times $\hat{\phi}_j^{\mu} Y_{ij}$

Tax Related Questions

- What is the distribution of carbon tax payments across sectors?
- What is the aggregate value of the income tax credit resulting from this policy?
- How many firms receive a tax credit greater than their carbon tax liability?
- Do firms have sufficient tax appetite to use the tax credit?

Cost of Tax Credit

Credit Limits?	Carbon Tax Payments	Tax Credit Cut-Off:			
		95%	90%	75%	50%
No	11,010	3,968	4,675	6,588	9,500
Yes	11,010	3,939	4,594	6,197	8,004

Millions of dollars

Carbon Taxes by Sector

			($ Millions)					
NAICS	Sector	Emissions Share (%)	Carbon Tax Owed	Value of Carbon Tax Deduction	Carbon Credit 95% Cutoff	Carbon Credit 90% Cutoff	Carbon Credit 75% Cutoff	Carbon Credit 50% Cutoff
331111	Iron+Steel	15.66	1,724	603	278	407	772	1,437
327310	Cement	9.78	1,076	377	632	700	917	1,042
325311	Nitrogen Fertilizer	7.57	834	292	732	751	763	819
325199	Organic Chem	7.07	779	273	213	258	389	506
322121	Paper	5.80	638	223	96	96	266	601
322130	Paperboard	5.78	636	223	269	307	415	608
325211	Plastics	5.23	576	202	80	147	224	371
325193	Ethyl Alcohol	4.92	541	189	223	274	412	513
331312	Primary Aluminum	4.77	525	184	169	185	283	636
325188	Inorganic Chem	4.21	464	162	118	119	154	228
325181	Alkalies/Chlorine	4.18	460	161	103	139	235	425
327410	Lime Manufacturing	3.95	434	152	244	305	403	439
325110	Petrochem	3.34	368	129	160	160	178	226
311221	Wet Corn Milling	2.31	254	89	67	137	188	210
331311	Alumina Refining	1.80	198	69	156	156	171	204
331419	Non-Fe Smelting	1.41	156	55	20	20	22	40
331511	Iron Foundries	1.35	148	52	41	57	77	114
322122	Newsprint Mills	1.06	117	41	77	86	95	106
331112	Ferroalloy Product	0.88	97	34	39	43	75	75
327213	Glass Containers	0.85	94	33	52	58	63	90

Sectors with Carbon Tax Credit Exceeding Income Tax Liability

NAICS	Sector	Emissions Share	Unusable Credits 95% Cutoff	Unusable Credits 90% Cutoff	Unusable Credits 75% Cutoff	Unusable Credits 50% Cutoff
331111	Iron+Steel	15.66	0.0	0.0	26.4	60.5
327310	Cement	9.78	97.1	97.4	98.0	98.2
325311	Nitrogen Fertilizer	7.57	87.3	87.6	87.8	88.7
325199	Organic Chem	7.07	0.0	0.0	0.0	0.0
322121	Paper	5.80	0.0	0.0	60.0	82.3
322130	Paperboard	5.78	76.4	79.4	84.7	89.6
325211	Plastics	5.23	0.0	0.0	0.0	0.0
325193	Ethyl Alcohol	4.92	0.0	0.0	27.1	41.4
331312	Primary Aluminum	4.77	86.6	87.8	92.0	96.5
325188	Inorganic Chem	4.21	0.0	0.0	0.0	26.6
325181	Alkalies/Chlorine	4.18	36.3	52.5	71.9	84.5
327410	Lime Manufacturing	3.95	98.6	98.9	99.2	99.2
325110	Petrochem	3.34	0.0	0.0	0.0	0.0
311221	Wet Corn Milling	2.31	0.0	36.8	53.9	58.8
331311	Alumina Refining	1.80	96.4	96.4	96.8	97.3
331419	Non-Fe Smelting	1.41	0.0	0.0	5.8	48.2
331511	Iron Foundries	1.35	0.0	0.0	0.0	0.0
322122	Newsprint Mills	1.06	91.2	92.2	92.9	93.6
331112	Ferroalloy Product	0.88	67.8	70.5	83.0	83.0
327213	Glass Containers	0.85	33.3	40.2	45.0	61.3

QFR Data Check

NAICS	Sector	Number of QFR Firms	Unusable Credits 95% Cutoff	Unusable Credits 90% Cutoff	Unusable Credits 75% Cutoff	Unusable Credits 50% Cutoff
	All 42 EITE Sectors	250	39.3	39.5	43.0	42.6
331111	Iron+Steel	20	14.4	14.7	29.0	43.0
325199	Organic Chem	30	10.0	10.2	12.4	18.4
325211	Plastics	30	68.3	69.7	70.5	71.2

Summary

- Output based credits provide better incentives to reduce emissions than tax deduction for carbon tax payment
  - Deduction reduces marginal emissions price by one-third
- Considerable variation in emissions intensity within sectors (and variation across sectors in the shape of the intensity distribution)
- Emissions intensity is higher in pre-1976 plants, larger plants, and less productive plants
- Considerable variation within sectors in the ability to use their carbon credits in given year
  - Variation largely driven by firms with zero or negative tax liability
  - Those firms don't benefit from carbon tax deduction either

Thank You

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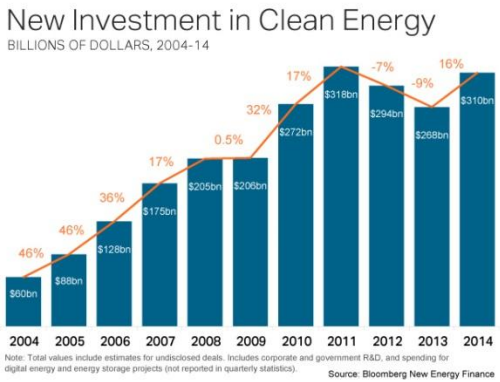
http://works.bepress.com/gilbert_metcalf/



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