Carbon leakage: theory, evidence and policy

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Climate Change

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Overview

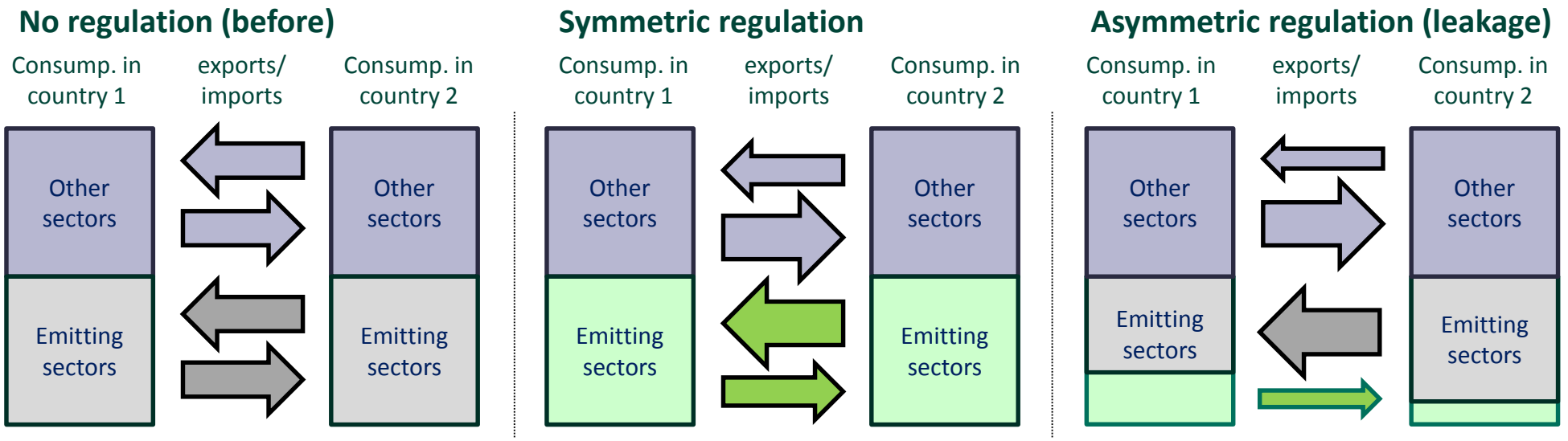
- **Definition**
- Theory
- Evidence
- Addressing leakage
  - Why?
  - Which sectors?
  - How?

The aims of carbon regulation

- There are various forms of carbon regulation including,
  - cap and trade schemes
  - carbon taxes
  - mandatory technology standards
- Carbon regulation aims to eliminate the "externality cost" of carbon emissions, and hence to reduce climate change
- It does this by "internalizing" the externality cost of carbon emissions, and ensuring the consumer of that carbon pays for the full damages to others (e.g. owing to climate change) caused by those GHGs
- Carbon regulation should promote substitution from high to low-carbon products, increase the competitiveness of more carbon efficient producers, and encourage firms to reduce their emissions intensity
- Owing to the complexity of a low-carbon transition, carbon regulation should be as flexible as possible to facilitate various potential decarbonization pathways – hence the importance of globally harmonized carbon prices

A definition of carbon leakage – competing firms facing different carbon emissions costs

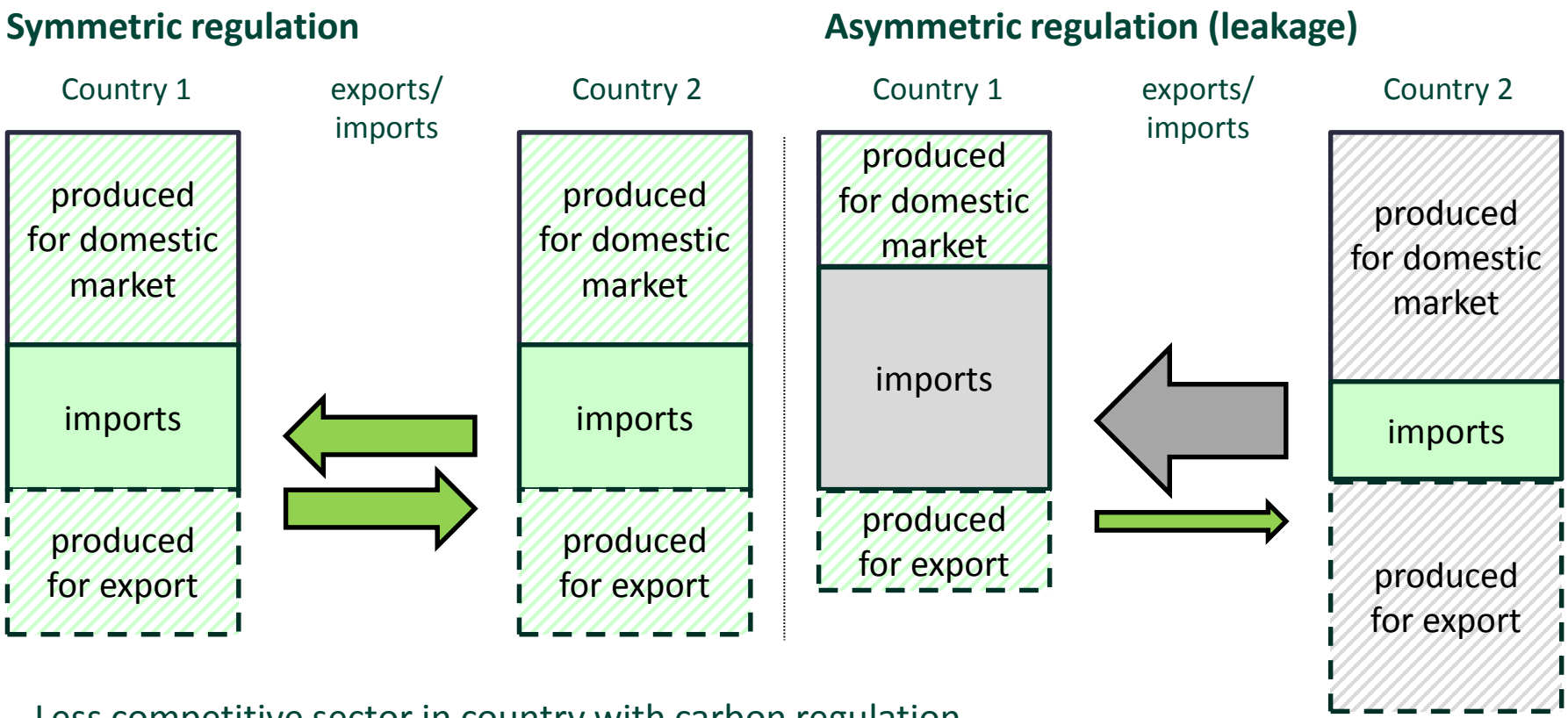
- Carbon leakage is the transfer of production (and hence emissions) owing to differences in carbon emissions costs from one jurisdiction to another as a result of differences ('asymmetries') in the stringency of carbon regulation



- **Before regulation:** trade occurs between the two countries based on various determinants of relative competitive advantage (not related to cost of carbon)
- **Symmetric regulation:** carbon emitting sectors in both countries become less carbon intensive, trade continues according to underlying determinants of relative advantage (with cost of carbon equal)
- **Asymmetric regulation:** less regulated country 2 will have lower cost of carbon, and hence export more in the emitting sector to the more regulated country 1 which will export less in the emitting sector

If it occurs, carbon leakage can have undesirable environmental, economic and political consequences

Dynamics in the emitting sectors



- Less competitive sector in country with carbon regulation
- Less production in country with carbon regulation
- Greater production in more emitting country (which may have even higher emissions intensity)
- Political pressure from companies and workers in the affected sector
- Less overall reductions in carbon emissions

A robust assessment of carbon leakage must take into account what would have happened under symmetric regulation

A counterfactual is key to establishing leakage rates

- leakage should be assessed by considering what happens as a result of differences in carbon regulation that would not have happened if regulation were equivalent across countries
- even under symmetric regulation, production (and remaining emissions) might shift from one country to another based on relative advantages in reducing carbon intensity
- more broadly, shifts in production and trade are due to a multitude of factors, including differences in labor costs, in innovation, in proximity to growing markets, in natural resource availability, etc.
- hence, observing declines in production and emissions in a regulated country, and increases in an unregulated country does not prove carbon leakage

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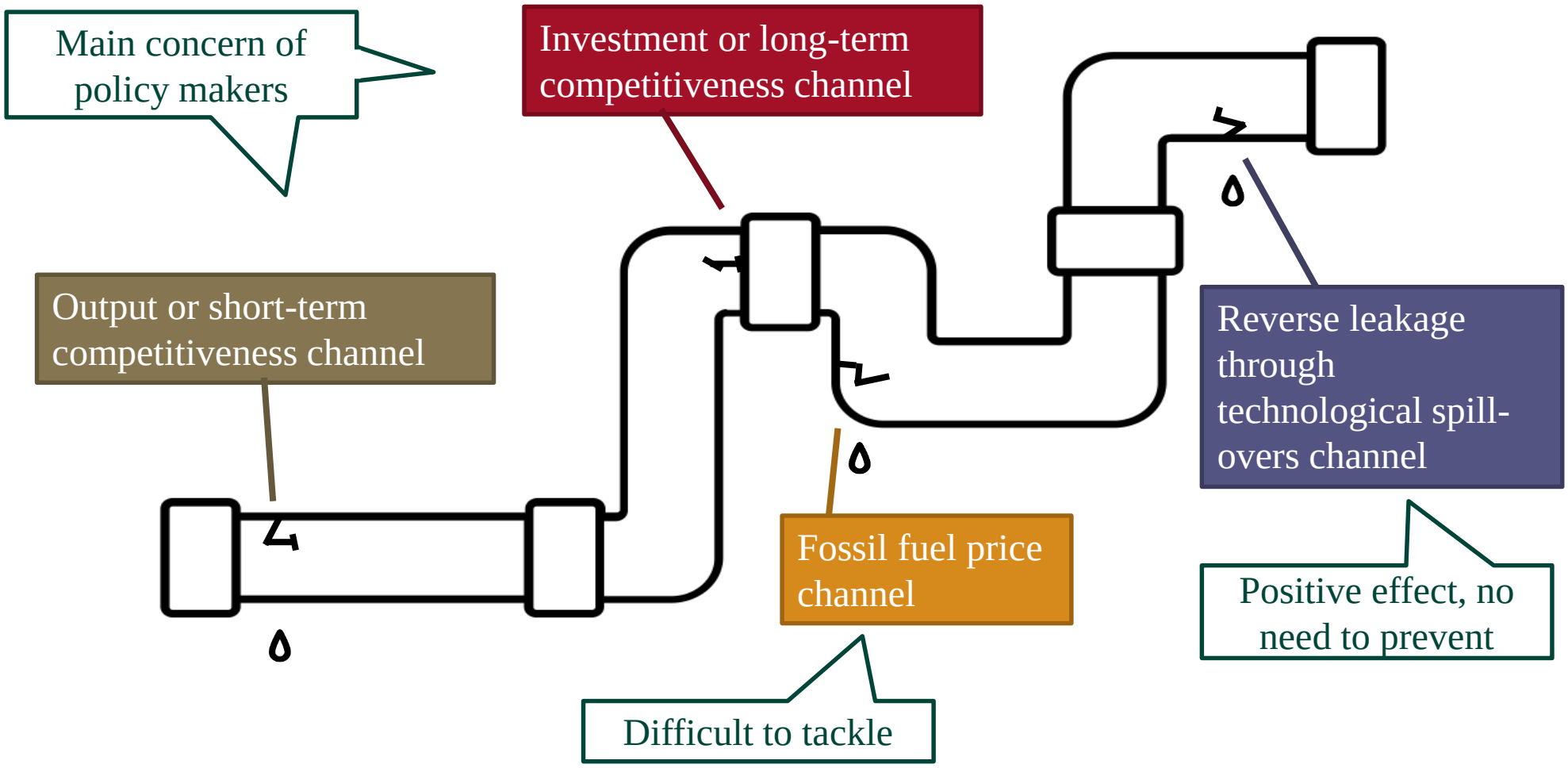
The four channels of carbon leakage



- Carbon leakage may be driven by both the direct and indirect costs of carbon regulation
  - **Direct** – The cost of carbon emitted directly by the production process
  - **Indirect** – The cost of carbon embedded in other inputs (e.g. energy, materials)

Distorted output decisions lead to leakage

Output or short-term competitiveness channel

The output or short-term competitiveness channel

- occurs if higher carbon costs for firms that are subject to policy leads to **a loss of market share** to firms that are not affected by policy
- note that if market share is lost to other firms that are subject to policy, this does not constitute carbon leakage
  - rather, this is the intended effect of the policy, as it may be due to differences in carbon intensity

Medium-long term changes in investment

Investment or long-term competitiveness channel

- **The investment or long-term competitiveness channel**
  - occurs if different carbon price **alters investment decisions** between countries in the medium-to-long term
    - in medium term, could occur through reduced investment in maintenance capital of covered firms
    - long term, plants in jurisdictions with carbon price may be closed and/or new plants may be built in regions without carbon price
    - challenging to establish cause-effect: other factors are usually more important than carbon price

Fall in demand reduces global fuel prices

Fossil fuel price channel

The fossil fuel price channel

- occurs if **global fossil fuel prices decrease** as a result of reduced demand in regions with carbon price
  - the fall in energy prices would increase demand in regions with less stringent carbon regulation
  - this in turn might increase emissions in these jurisdictions

Spurring innovation through regulation

Reverse leakage through technological spill-overs channel

The technological spill-overs channel

- occurs if carbon prices **induce innovation that enhances competitiveness**, implying that more production occurs in regulated regions
- carbon price-induced innovation and ensuing competitiveness gains could improve international competitiveness of firms
- the increase in international market share of regulated firms constitutes negative leakage

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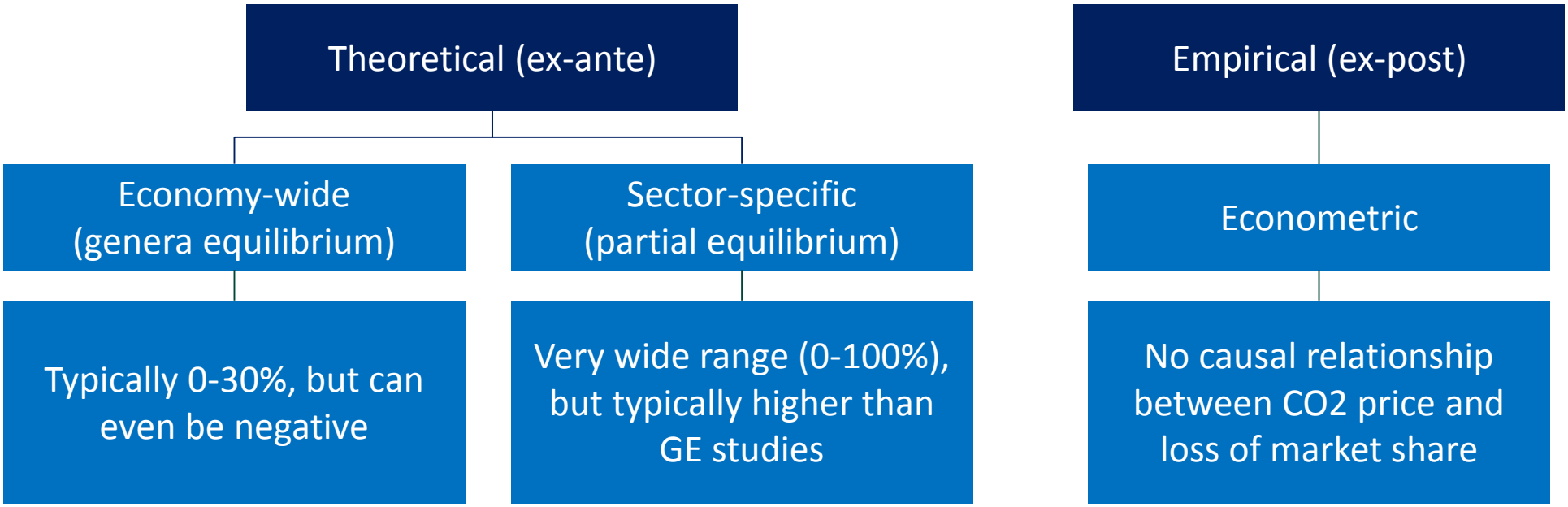
There are various approaches to assessing the existence and extent of carbon leakage



- Fairly large difference exist both within and between modelling approaches
- All approaches make simplifying assumptions which affect their validity, in particular, models tend to divide the world in a binary fashion between jurisdictions with a carbon price, and those without a carbon price
- Results from one modelling exercise can not be applied to other localities or sectors – degree of leakage depends significantly on context!

Mixed evidence requires policy judgement, with pressure for action likely to remain

- Significant evidence exists that carbon leakage is not as large a problem as some claim – general equilibrium and empirical studies find low to moderate leakage,
- there is evidence that some policies to prevent leakage lead to reducing the effectiveness of carbon regulation
- and as more countries adopt carbon prices, the relative asymmetries should diminish over time.
- **Yet**, partial equilibrium studies, anecdotal evidence and industry lobby suggest potential for higher leakage rates,
- and any carbon leakage would not only hurt local industry, but also diminish the effectiveness of carbon regulation
- **Typically, risk of leakage continues to lead to policy response**

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Motivation for containing leakage risk

- Recap: preventing risk of carbon leakage may be motivated by two concerns
  - safeguard carbon abatement and cost-effectiveness of the carbon pricing regime; and
  - respond to concerns from affected firms and industries
- the challenge for policy-makers is twofold
  - they must correct for issues that arise when carbon prices are not globally harmonized (preventing "inefficient leakage", i.e. increase in market share for unregulated producers),
  - while at the same time avoid undermining the benefits that are expected from carbon pricing in the first place (promoting "efficient leakage", i.e. increase in market share for less emissions intensive producers)
  - In general, these two aims are in conflict, and policy-makers must work to balance one against the other
- **To best balance these objectives, policy-makers face two primary decisions:**
  - which sectors to support; and
  - which mechanism for providing assistance to use

Determining sectors at risk

Which sectors?

- Policy makers must decide how to set eligibility and assistance thresholds
  - policy makers have generally used carbon intensity (as measure of *impact* of carbon pri*ces)* and trade exposure (as measure of *exposure* to competition) of sectors or firms
    - these indicators determine eligibility for assistance and separate assistance categories into tiers
  - for example in the EU, sectors are eligible that
    - face a cost increase of >30%,
    - have a trade intensity of >30%, or
    - face a cost increase of >5% and trade intensity of >10%

Support choices differ across schemes

Which sectors?

Exclusion of power sector, and reduction of assistance to some non-power sectors in Phase III of the EU ETS reflected the recognition that previous assistance led to windfall gains and abatement inefficiencies

Scheme and period	Treatment of generators	Treatment of non-generators	Type of assistance (tiered or uniform)
EU ETS (Phase I and II)	Included	All entities given assistance	Generally offered to all entities on uniform basis
Chinese ETS pilots	Included	All entities given assistance	Uniform
Korea	Included	All entities given assistance	Uniform
South Africa (2016-2020)	Included	All entities given assistance	Tiered based on trade exposure and the level of process emissions
EU ETS (Phase III)	Generally excluded	All entities given assistance	Uniform
New Zealand	Excluded	Limited to activities that meet eligibility criteria	Two tiers: highly and moderately exposed to leakage

Other criteria for assessing leakage risk

Which sectors?

- **Price sensitivity of consumers** – if consumers are very price sensitive, this is likely to lead to greater leakage, and vice versa
- **Nature of competition within a sector** – tougher competition in a given industry would likely lead to greater leakage and vice versa
- **Availability and cost of abatement options** – a lack of abatement opportunities at reasonable cost would likely lead to greater leakage, and vice versa
- **Carbon pricing (implicit and explicit) among competitors** – if competing jurisdictions do not have any form of carbon pricing, this is likely to lead to greater leakage, and vice versa
- **Carbon intensity of production in other jurisdictions** – if other jurisdictions are significantly less carbon intensive, then leakage would be less of an inherent concern, and vice versa

Types of integrated measures

- Four types of integrated measures have been extensively used and/or discussed in literature
  - free allowance allocations (based on output, grandfathering or fixed sector benchmarks)
  - administrative exemptions
  - rebates (either direct or through changes in other tax)
  - border carbon adjustments
- These measures can all be targeted at specific sectors
  - as discussed previously, there may be merit in narrowly targeting exposed sectors

Free allowance allocations

- To date, free allowance allocation is the most common policy to address leakage
  - Approaches to free allocation can be usefully distinguished with two questions:
    - does the number of free allowances received by a firm vary (quickly) as its output changes?
    - is the number of free allowances received by a firm linked to the firm's actual emissions?
  - this gives rise to four categories of approaches to free allocation, as per the next slide
    - notably, some countries, including Australia and Korea, apply different approaches across sectors

How?

Four approaches to free allowance allocation

		Do allocations vary in proportion to a firm's output?	
		Yes: allocations update with the firm's own output on a regular basis	*No: allocations are based on a firm's historical output with occasional periodic updating*
Do allocations vary in proportion to a firm's emissions intensity?	**Yes: allocations are directly proportional to the firm's own emissions intensity**	Virtual exemption: This would effectively eliminate the carbon price	Grandfathering: allocations are directly based on a firm's historical emissions and do not vary as output changes, except between phases
		Examples: none based on allocations	Examples: EU ETS Phases I and II; Korea (all but three sectors); Kazakhstan Phases I and II; Beijing; Chongqing; Guangdong; Hubei; Tianjin
	No: allocations are benchmarked to an independent measure of emissions intensity	Output-based allocation (OBA): Allocations are proportional to sector-wide benchmarks and a firm's current output levels	Fixed sector benchmark (FSB) allocation: allocations are proportional to sector-wide benchmarks and firm-specific historical activity levels. Adjustments for changes in output only between phases
		Examples: California; New Zealand; Australia; Korea (three sectors); Shenzhen	Examples: EU ETS Phase III

Administrative exemptions

- Administrative exemptions can be set for a number of reasons including
  - practical difficulties in coverage
  - political concerns around imposing costs on a sector
  - leakage concerns, **usually associated with a carbon tax**
- Often used for e.g. small emitters, transport emissions, land use, and waste, where it is deemed too difficult or expensive to cover them with carbon regulation
- But has been used as a way to avoid carbon leakage
  - Germany combined a broad energy tax with exemptions for energy-intensive processes
  - Finland and Denmark provided tax refunds on large proportion of their energy taxes for energy-intensives

Rebates

- Rebates (e.g. reductions in other taxes) are similar to exemptions, and can be given for similar reasons
- They may or may not be explicitly calculated to ensure the rebate results in revenue neutrality for government
- Examples include,
  - In the UK, and offset in the national insurance contribution was provided to firms affected by the Climate Change Levy
  - In Denmark, increases in energy taxes were accompanied by reductions in employers' contributions to pension fund and national insurance

Border carbon adjustments

- Border carbon adjustments have a different impact from free allowances
  - these involve a carbon price imposed at the border on emissions intensive goods, and/or rebates provided to exporters
  - a fundamental difference between BCAs and free allowances is the effective extension of the carbon price to entities outside the jurisdiction
- BCAs have not been widely implemented
  - California has a rule akin to a BCA, covering electricity importers, and considers cement BCA
  - The US imposed a BCA-like scheme with regard to ozone-depleting chemicals

Pros and cons of different options

- Each design option has its pros and cons, but, all else being equal:
  - exemptions can effectively address leakage but perform most poorly in terms of abatement incentive, and any adjustments to improve abatement incentive will reduce leakage protection
  - free allocation performs better but its merits depend on the exact approach taken
    - grandfathering is technically simple, but reducing leakage involves compromising abatement incentives, since updating and closure rules that reduce leakage also increase inventive to continuing high emissions levels
    - fixed sector benchmarking can better achieve both goals, but calculation of benchmarks is more data-intensive
    - both grandfathering and FSB carry a risk of delivering windfall gains
    - output based allocations can better target leakage, and reduce windfall gains, but reduce incentives to improve efficiency if applied to sectors not exposed to leakage
  - Rebates can be designed to resemble free allocation approaches with similar pros and cons
  - BCAs perform best in terms of reducing risk of leakage but face political, administrative and potentially legal challenges

How?

Pros and cons of different options (ctd.)

	Grandfathering	FSB	OBA	Exemption	Rebates	BCA
Leakage prevention	Weak, unless closure rules and updating included	Weak, unless closure rules and updating included	Strong	Strong	Depends on design	Strong
Incentives to improve emissions intensity	In principle strong, but diluted when updating included	Preserved	Preserved	Not preserved	Preserved	Preserved
Demand-side abatement incentives	Preserved	Preserved	Dulled, especially if applied too broadly	Removed	Depends on design	Preserved
Administrative complexity	Easy to implement	Some complexity in establishing benchmarks	Some complexity establishing benchmarks, collating output data	Easy to implement	Some complexity	Very complex
Risk of windfall profits	Some risk	Some risk	No	No	No	No
Risk to environmental outcome	No	No	Some risk, depending on design	Yes, exempt emissions uncapped	Depends on design	No
Political and legal challenges	No	No	No	No	No	Yes

Thank You

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