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**Conference Paper**

## The Global Effects of Subglobal Climate Policies

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# The Global Effects of Subglobal Climate Policies

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Based on paper with  
Knut Einar Rosendahl (Statistics Norway)  
and  
Carolyn Fischer (Resources for the future)



# Introduction

- Individual OECD countries (EU, US) are implementing policies to reduce greenhouse gas emissions
  - EU ETS (since 2005)
  - US cap-and-trade?
- Emerging economies lack comparable regulation – raises concerns about
  - Competitiveness of energy intensive industries
  - Carbon leakage
- As a response, controversial trade-related measures and allowance allocation designs are being proposed



# Measures in Current Proposals – EU

## EU ETS Phase III – from 2013-2020:

- (Almost) no allocation of allowances to power industry
- Substantial allocation of allowances to other industries
  - Sectors with significant risk of carbon leakage: 100% of "benchmark"
    - ◆ Cost increase above 30%, OR Trade intensity above 30%, OR Cost increase AND trade intensity both above 5%
    - ◆ Includes extraction of fossil fuels
  - Other sectors: 80% (2012) → 30% (2020)
- Allocation is proportional to historic *production*
  - Revised if capacity is changed (including new entrants)
- Similarities with Output-based rebates
- Border carbon adjustment policies not on the table before 2020



## Measures in Current Proposals – US

- American Clean Energy and Security Act of 2009 (ACESA) has provisions for “Ensuring Real Reductions in Industrial Emissions”
  - Passed by the House, not yet by the Senate
- Output-based rebates (OBR) of allowances for energy-intensive, trade exposed sectors (EITE)
  - EITE: 5% energy (or CO<sub>2</sub>) intensive and 15% trade intensive, or 20% energy intensive (more restrictive than EU ETS)
    - ◆ 100% of “benchmark”
  - Offsets domestic production cost increases (on average) from emissions liabilities
- Border carbon adjustment (BCA) for imports
  - Removes cost advantage for unregulated foreign competitors
  - Transition from OBR to BCA from 2020
  - Could also consider BCA for exports



## Why are such measures necessary?

- EITE sectors are small share of economy (US: <6% of GDP and 10-20% of total emissions) but vocal, organized and unionized
  - US: Senators from key states
- Hard to ask sectors to take on costs when significant shares of their reductions may be offset by increases abroad
- Welfare costs per *global* emission reduction may be reduced
- Alternatives (exemptions, weak climate legislation) worse



# Why are trade-related measures controversial?

- Fears of disguised protectionism
- WTO obligations
  - Nondiscrimination
  - Can regulate products, not processes
  - Some exceptions for environmental purposes
  - Least-trade restrictive alternative
  - Restrictions on subsidies
- Negotiations in WTO and UNFCCC already difficult



## What's missing from the debate?

- Focus has been on targeted EITE sectors
- Need broader understanding about how climate policies implemented unilaterally (or sub-globally) affect all countries in the global trading system.
- Largest impacts are from the targeted carbon pricing itself, which generates
  - macroeconomic effects,
  - terms-of-trade changes, and
  - shifts in global energy demand and prices
  - changing the relative prices of energy-intensive and non-energy-intensive goods.





## **This Paper (Böhringer, Fischer, Rosendahl)**

- Effects of climate policies implemented in the EU and/or US on global distribution of economic outcomes and carbon leakage
- How these outcomes may be altered by a variety of complementary policies aimed at addressing carbon leakage.



# Numerical Model

- Global multi-sector, multi-region computable general equilibrium (CGE) model based on GTAP7 database
  - Detailed accounts of regional production, regional consumption, bilateral trade flows, energy flows and CO2 emissions
  - Static model with 2004 base year
- Assumptions:
  - No change in policies in other countries
  - No cap on emissions in Annex B



# Energy and EITE Sectors

- Energy Goods
  - Coal (COL), Crude oil (CRU), Natural gas (GAS), Refined oil products (OIL), and Electricity (ELE).
- EITE Goods
  - Chemicals (CRP);
  - Non-metallic minerals, including cement and glass (NMM);
  - Pulp, paper, and print (PPP);
  - Iron and steel (I\_S);
  - Nonferrous metals, including copper and aluminium (NFM).
- Other Goods/services
  - Transport
  - Rest-sector



## Some model features

- Bilateral trade:
  - Armington approach of product heterogeneity
    - ◆ Exception: Crude oil (homogeneity)
    - ◆ Armington elasticities taken from GTAP7
- Fossil fuel supply:
  - Supply elasticities equal to one
- Resources:
  - Fixed endowment of labour and capital
  - Fixed investment and government expenditures
- Welfare:
  - Hicksian equivalent variation (HEV) in income



# Policy Scenarios

- US and/or EU reduce emissions by 20%
  - No international trading
- Different treatment of EITE sectors

	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>
<b>1</b>	U.S. AUCTION	U.S. OUTPUT	U.S. REBATE	U.S. TARIFF	U.S. BTAX
<b>2</b>	EU AUCTION	EU OUTPUT	EU REBATE	EU TARIFF	EU BTAX
<b>3</b>	U.S.&EU AUCTION	U.S.&EU OUTPUT	U.S.&EU REBATE	U.S.&EU TARIFF	U.S.&EU BTAX

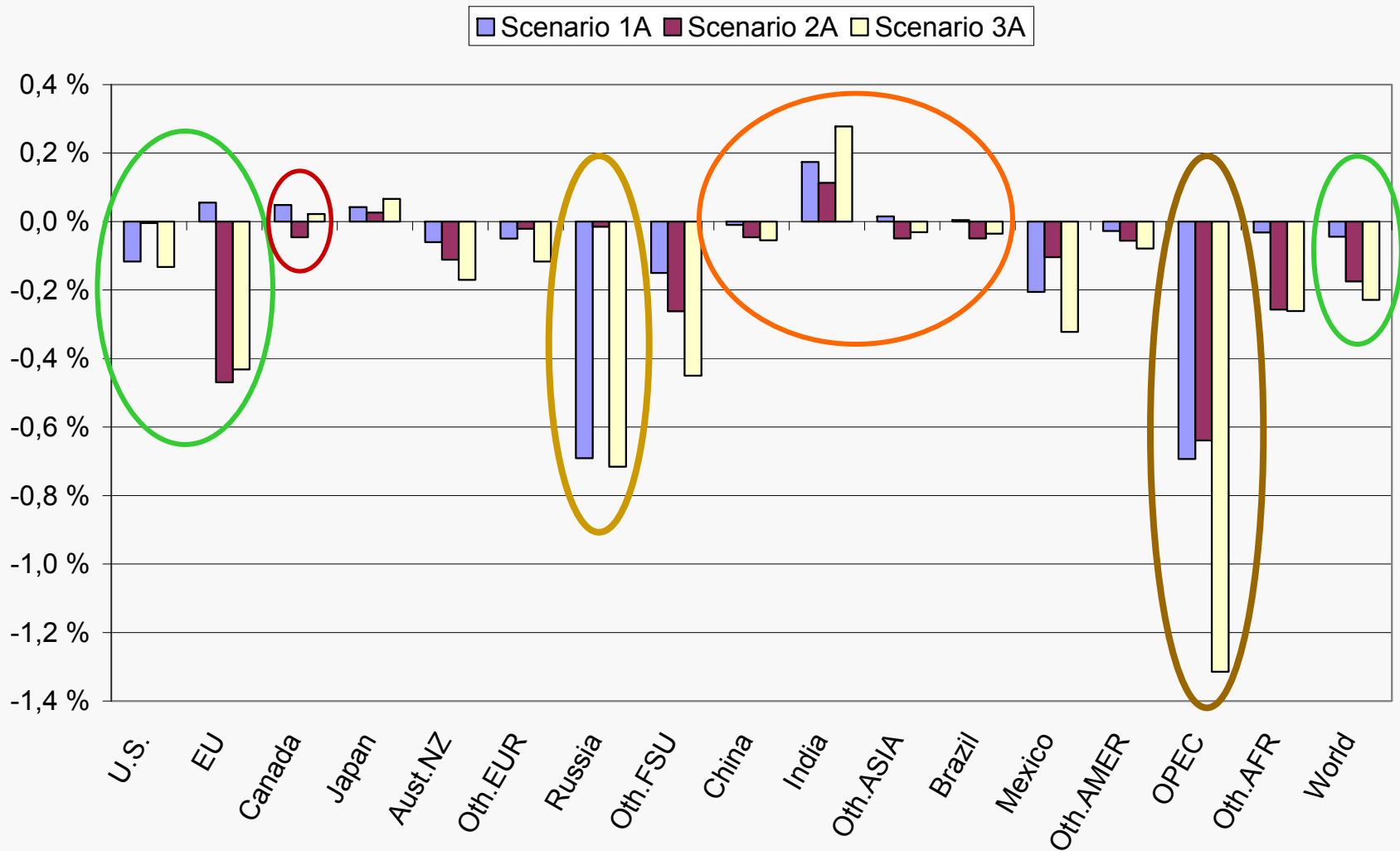


## Results of Auctioned Allowances

- Welfare costs substantially higher in the EU than in U.S.
  - U.S. has cheaper abatement options:  
Carbon prices are \$60/ton C for the U.S., and \$125/ton C for the EU.
    - ♦ (\$16 and \$34/ton CO<sub>2</sub>)
    - ♦ (\$63 and \$129 when jointly implemented)
  - Different trade intensities and terms-of-trade effects.
    - ♦ Natural gas prices are stimulated by the climate policies, whereas coal and crude oil prices are depressed.
    - ♦ EU is net importer of all three fossil fuels, whereas U.S. was a net exporter of coal in 2004.
- Welfare effects of unilateral policies can be quite different for different trade partners
  - Larger for some countries than for the US/EU



# Welfare effects of auctioned allowances in U.S. (Scenario 1A) , the EU (2A) or both (3A)





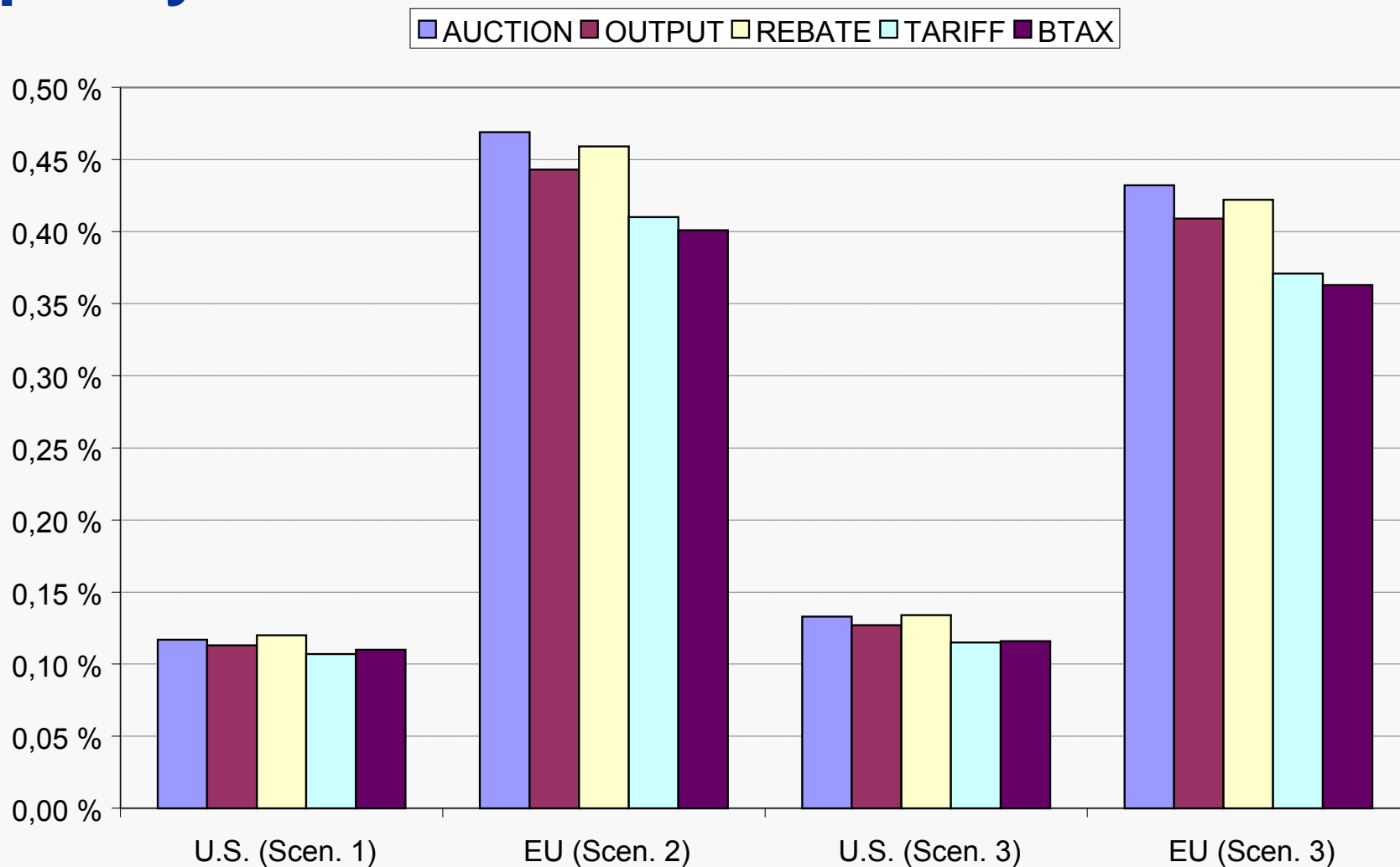
## Effects of additional policies

- Not valuing the additional benefits of avoided leakage
  - Alternative assumption: Keep global emissions fixed
- Effects of other policies small but positive
  - beneficial terms of trade effects from protecting EITE sectors in these two large economies
  - Larger for EU, in which EITE larger share of emissions
- U.S. carbon price is not sensitive to the adjustment policies, while the EU carbon price rises 2% in the OUTPUT scenario and 4% with BTAX.





# Welfare costs in the U.S. and the EU by policy scenario



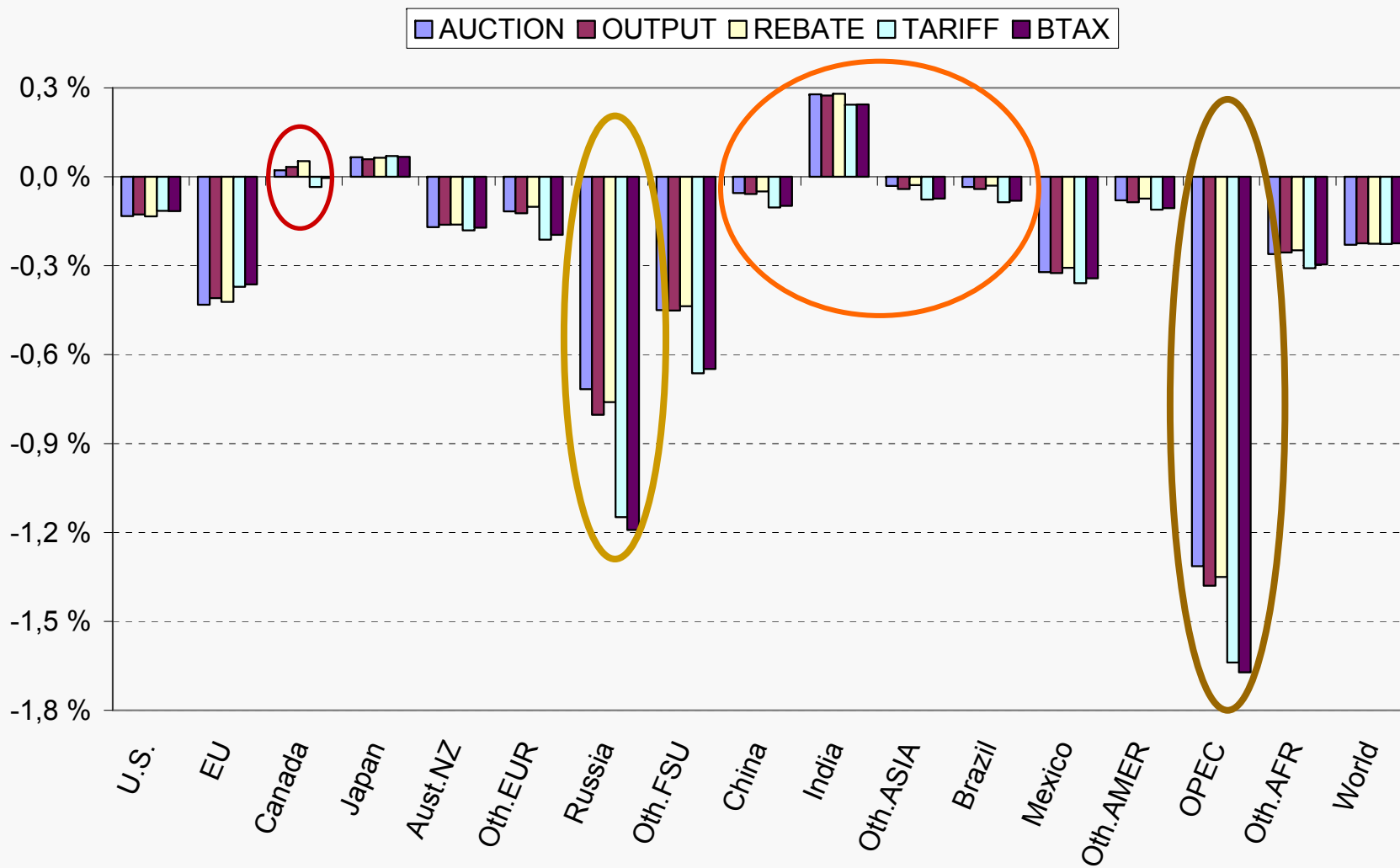


## Welfare effects for other regions

- Moderate differences for most regions and negligible for the world as a whole.
- Losses for crude oil and coal exporting regions are generally highest when the U.S. and the EU also impose import tariffs
  - Demand for fossil fuels outside these two regions are lower than in the other scenarios,
- Import tariffs also negatively affect exporters of energy-intensive goods, notably China, India and Canada.
  - Adjustments based on exporters' emissions intensities



# Welfare effects in different regions of joint caps in US and EU



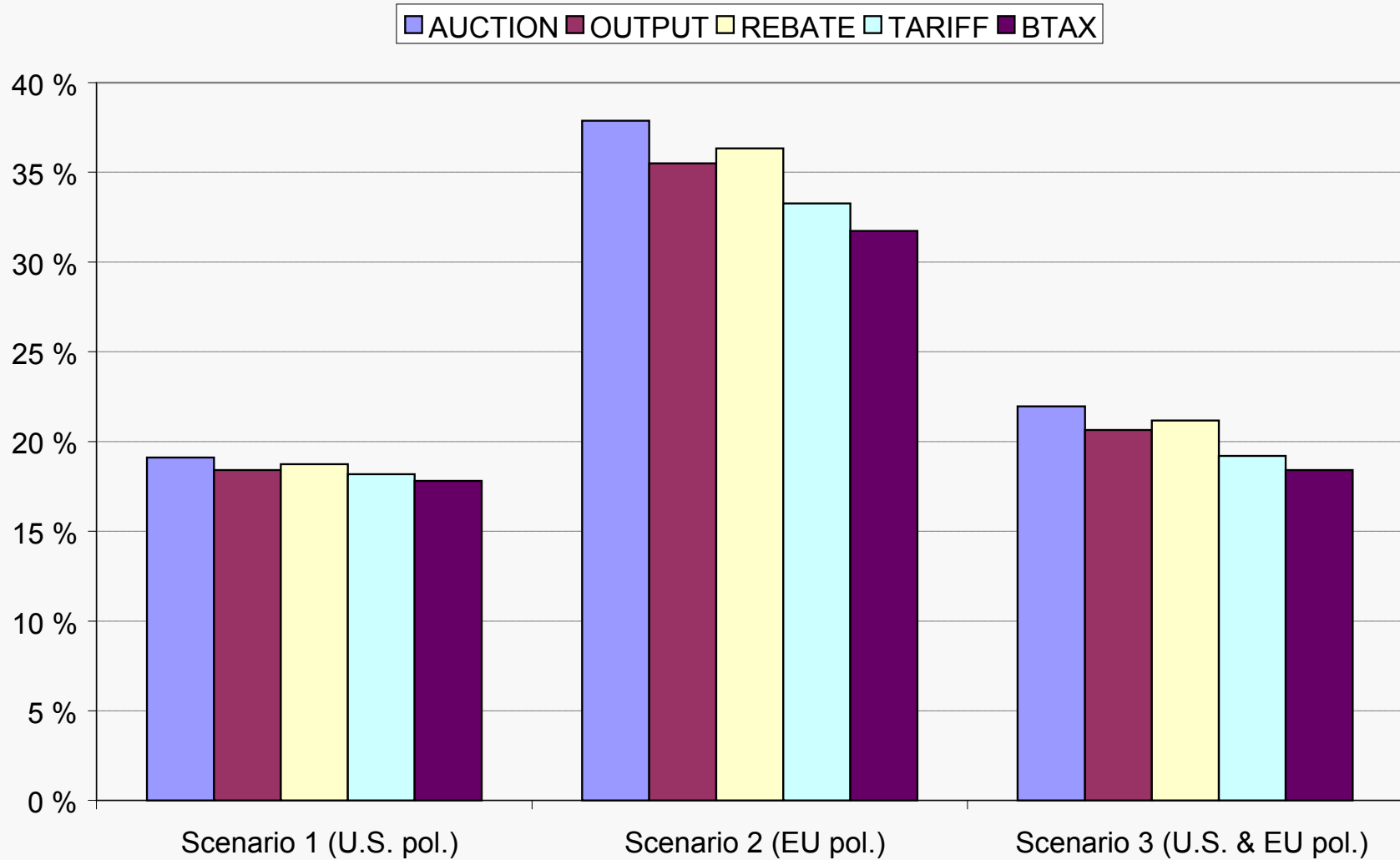


## Effects on Leakage

- Carbon leakage highest with unilateral EU cap
  - Up to 38%, compared to 19% for U.S.
  - EU is a more open economy than the U.S.
  - EU is a much bigger importer of fossil fuels
  - EU EITE industries less carbon-intensive
- When both regions reduce emissions, the leakage rates are closer to the U.S. policy scenarios.
  - U.S. has higher emissions than the EU
  - Joint caps eliminate EU-US leakage
- Policies limited in reducing leakage
  - Address production shifting, but not energy markets
  - Full border adjustment most effective



# Global Leakage Effects



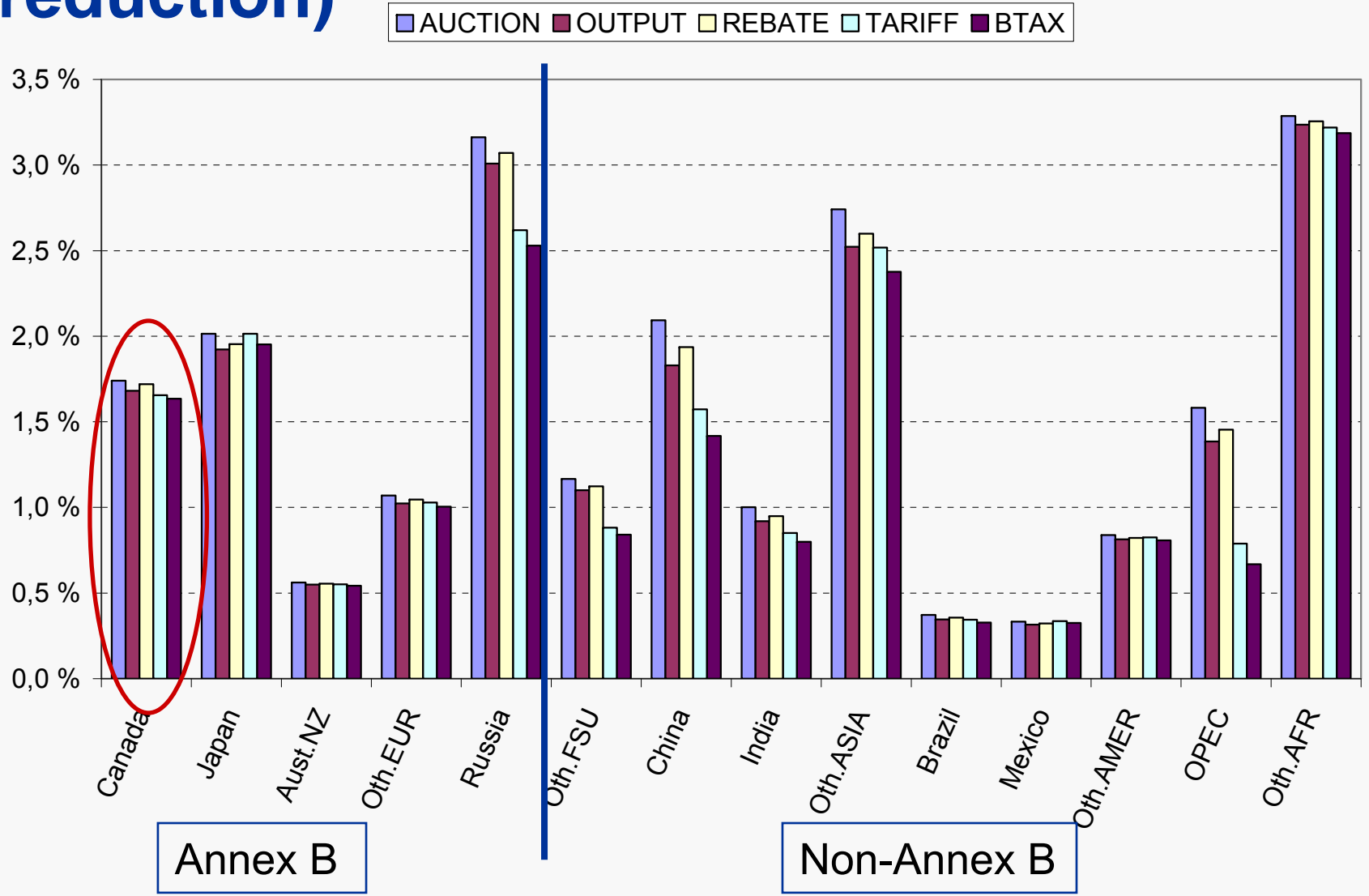


## Distribution of Leakage

- 40% of leakage to Annex B countries
  - Large share to Russia
  - More for US unilateral policy
- Effects of adjustment policies
  - Hardly reduce leakage to other OECD countries, and also to Latin American and African countries.
  - The largest impacts on leakage are in Asian countries, former Soviet Union, and OPEC.



# Leakage Rates by Region (US&EU reduction)





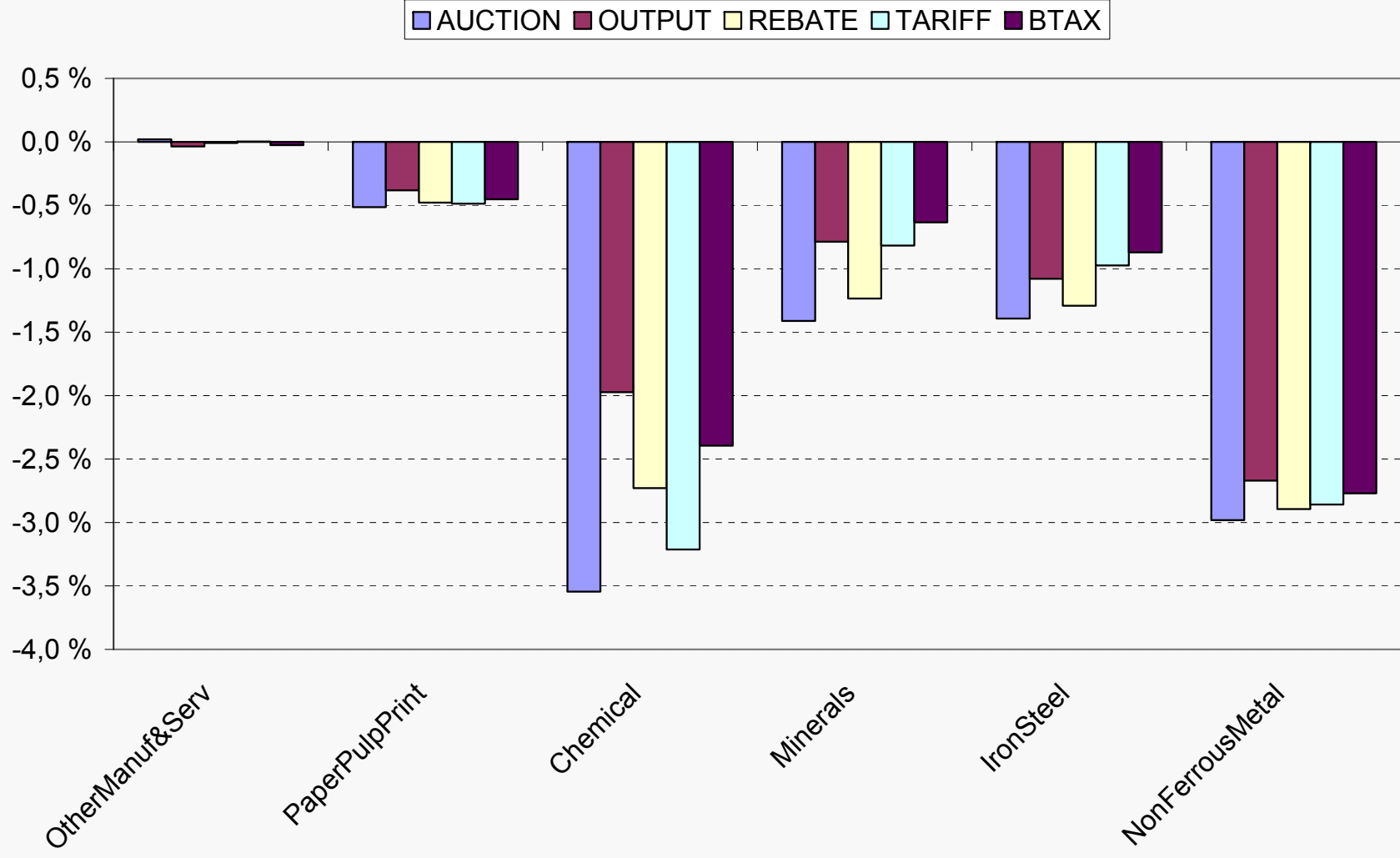
# Effects on EITE competitiveness (production)

- Both output-based allocation and border adjustment policies dampen the production decrease.
  - Largest impacts in the EU
  - Full border adjustment usually most effective
  - Output-based allocation has about the same effect as import tariffs alone.
  - Small effects on electricity-intensive sectors
    - ◆ Not adjusting for indirect emissions
    - ◆ If the import tariffs also take into account indirect emissions (i.e., from electricity production) embodied in the products, production of non-ferrous metals in the EU will actually increase



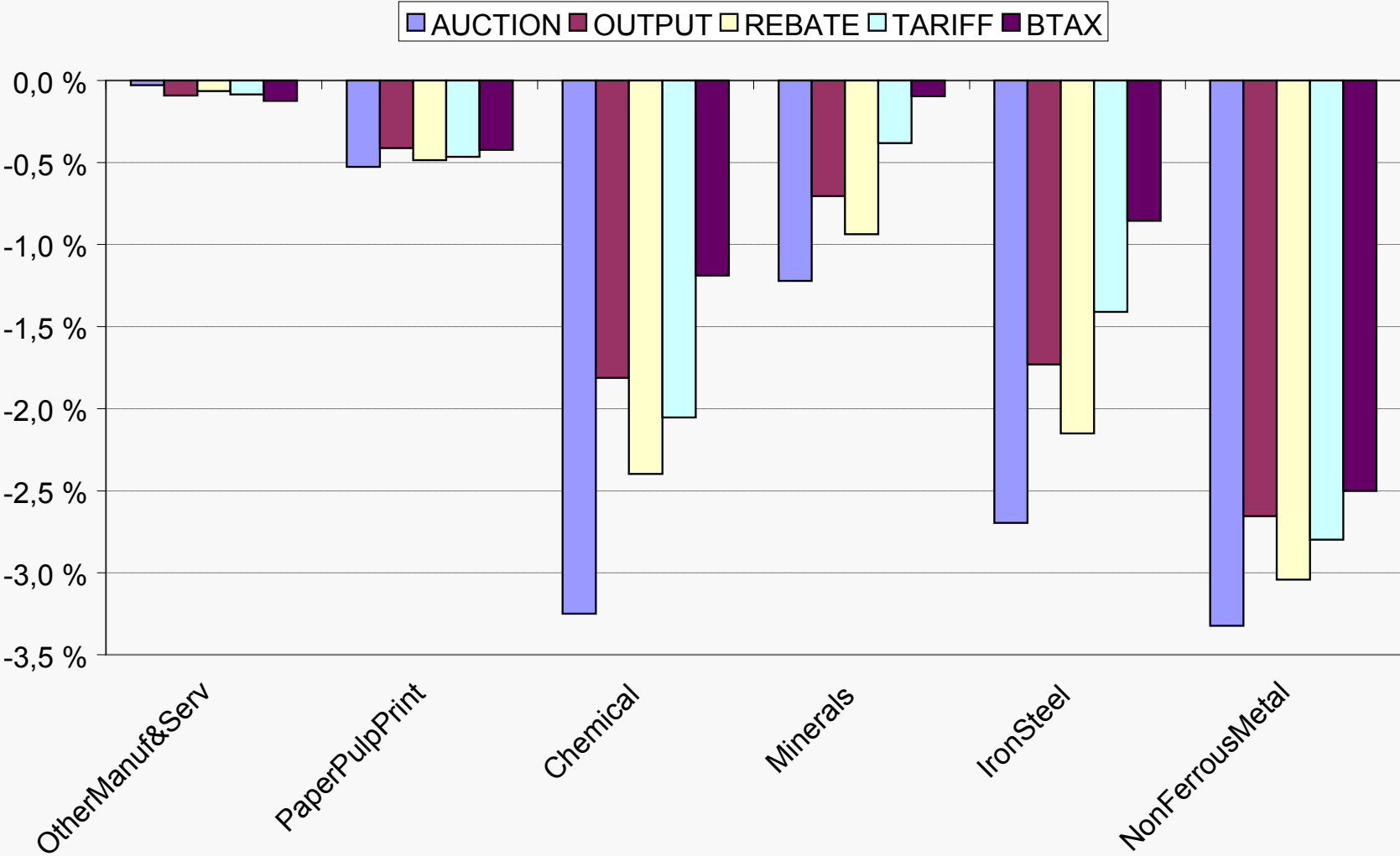


# Effects on U.S. production of different U.S. climate policies





# Effects on EU production of different EU climate policies



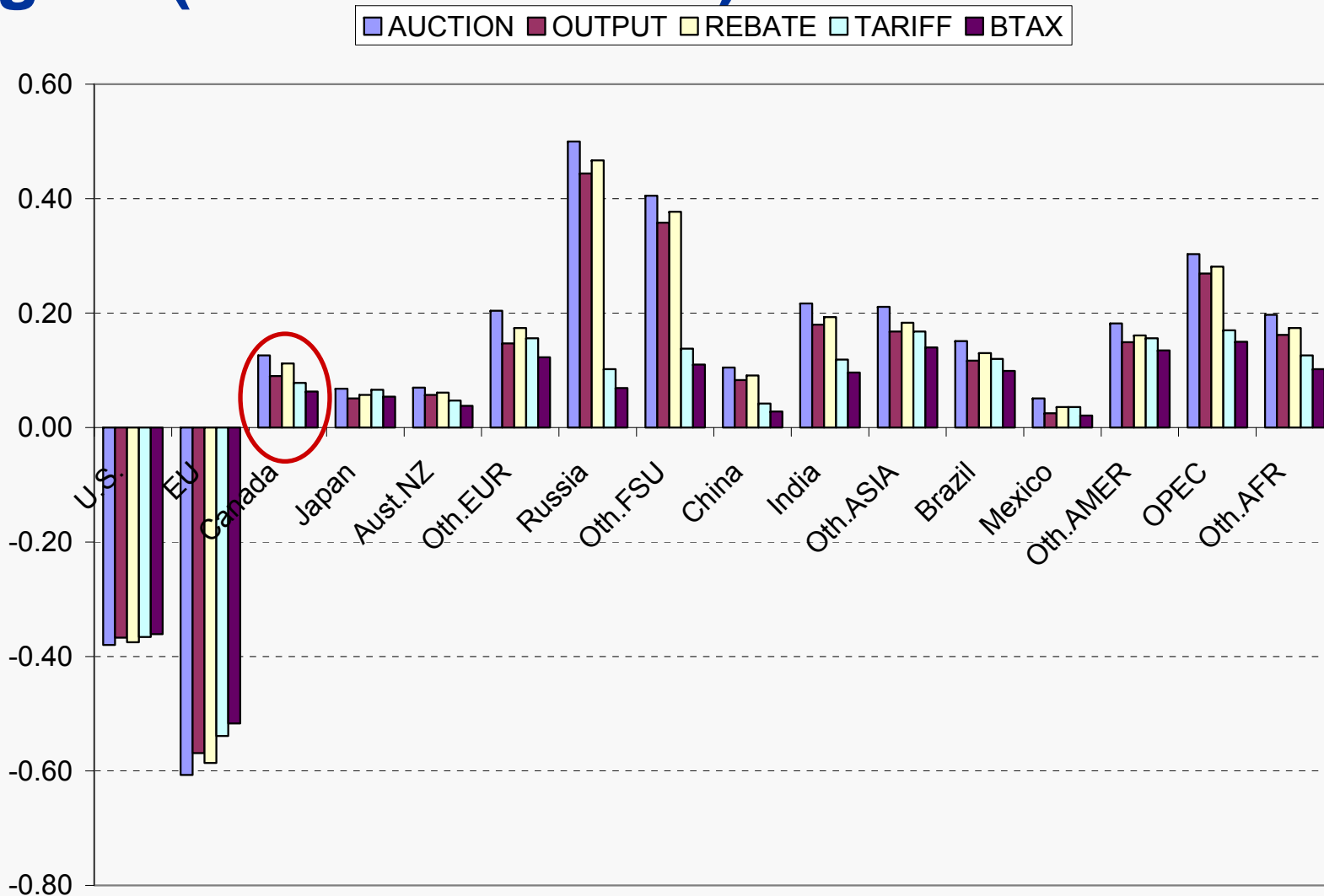


# Competitiveness in Non-implementing Regions

- Production in EITE sectors increases across the board
- “Rest-sectors” experience production decreases in all countries except OPEC.
  - “Rest-sectors”: Excluding Energy, EITE and Transport sectors
- Adjustment policies in part shift production in the other regions back toward “Rest-sectors” from EITE.
- Aggregate production remains higher across the board with adjustment policies than with no climate policy action
  - Similar effects on EITE exports
- Welfare is determined by consumption rather than production, so while other regions reap competitiveness benefits, most remain worse off.

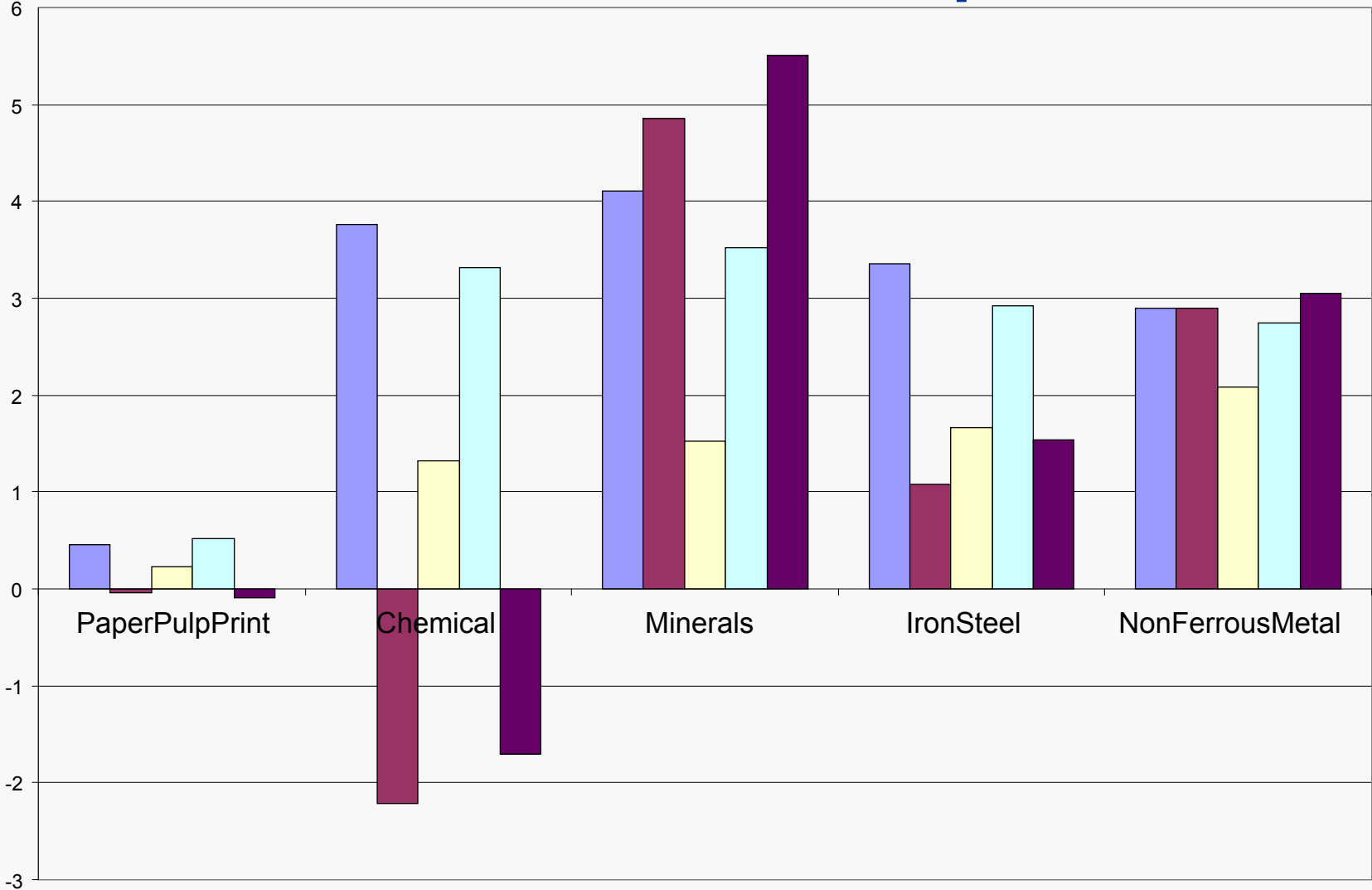


# Percentage Change in Total Production, by Region (US&EU reduction)



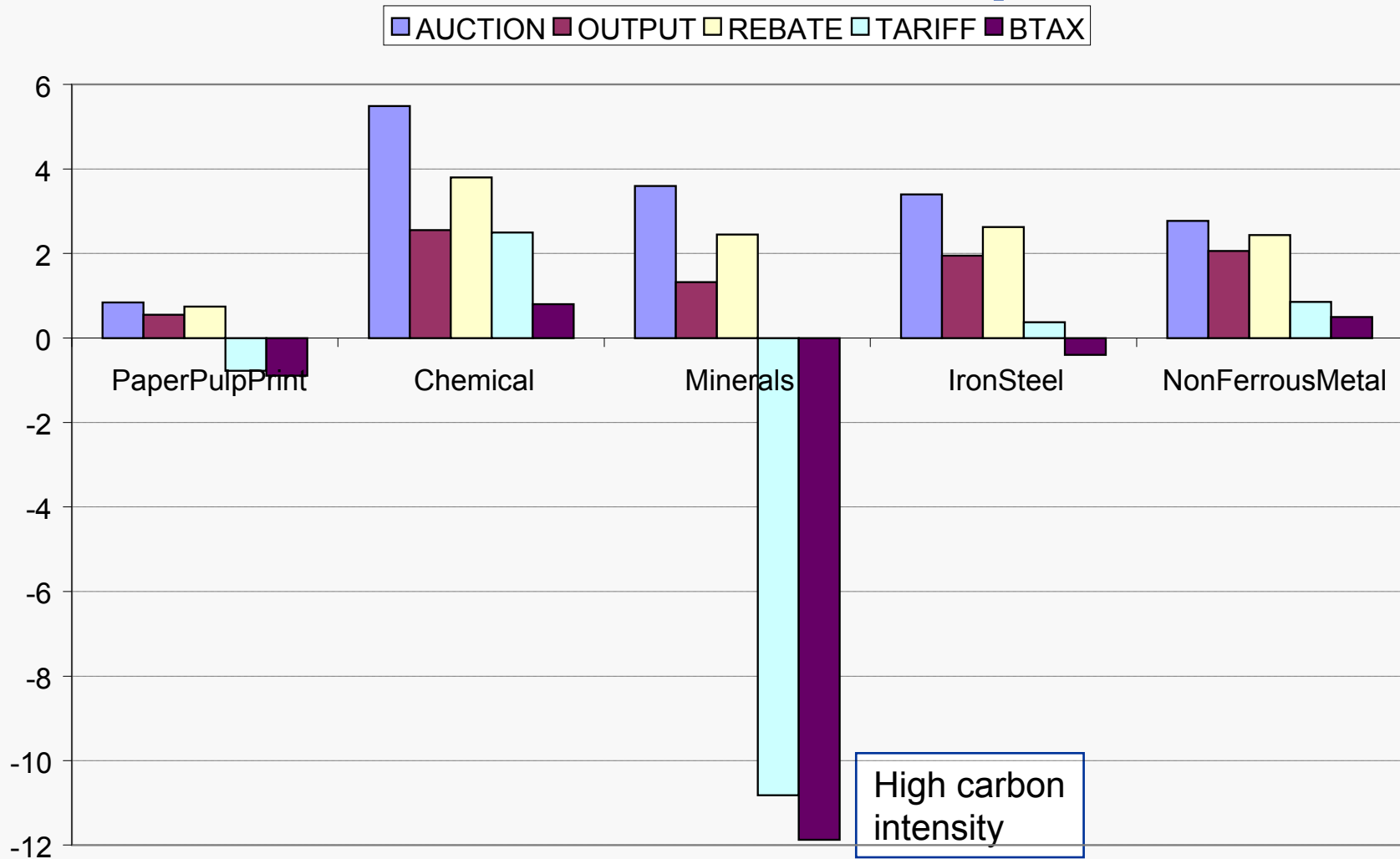


# Effects on Canadian EITE exports of different U.S. and EU climate policies



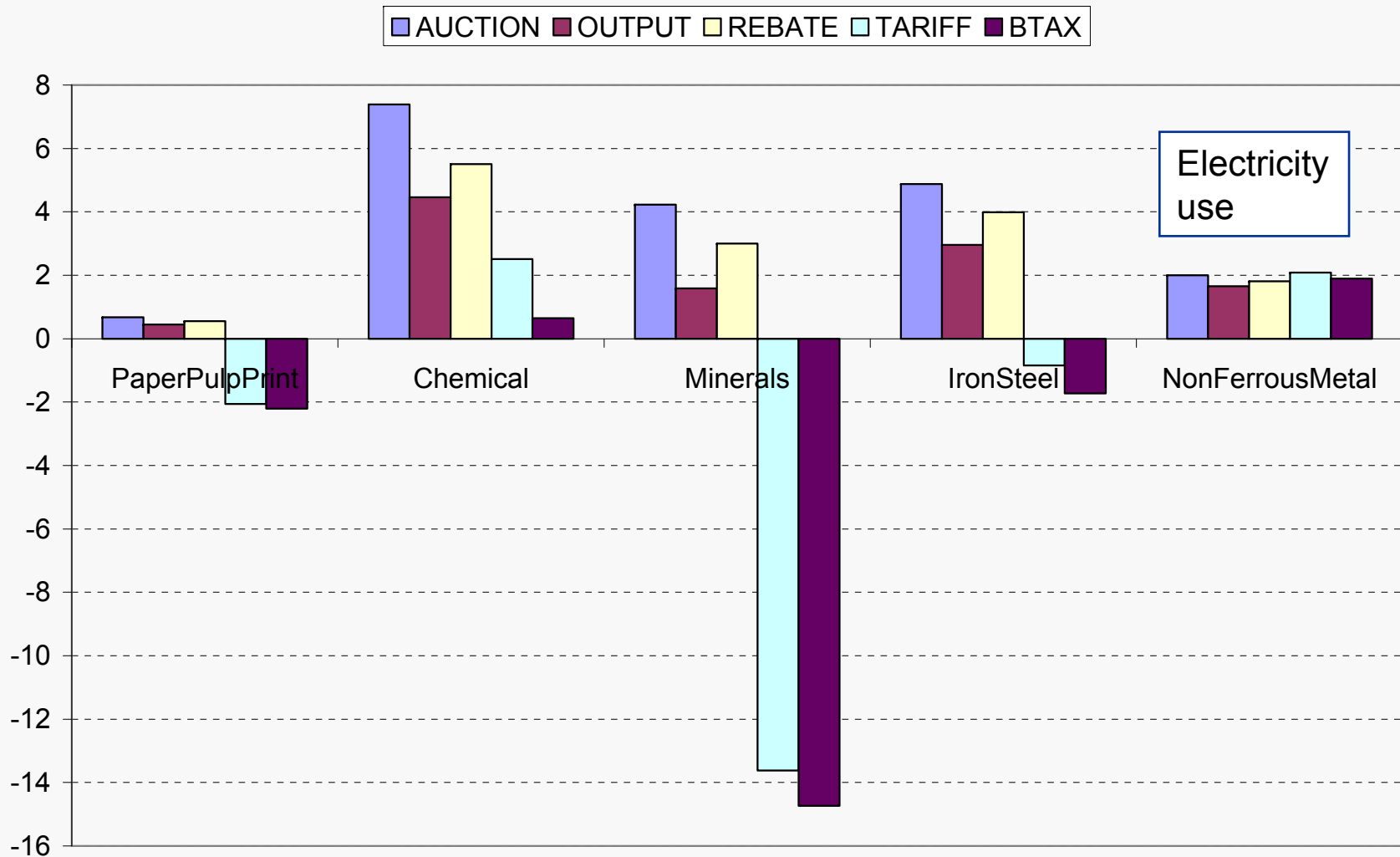


# Effects on Chinese EITE exports of different U.S. and EU climate policies



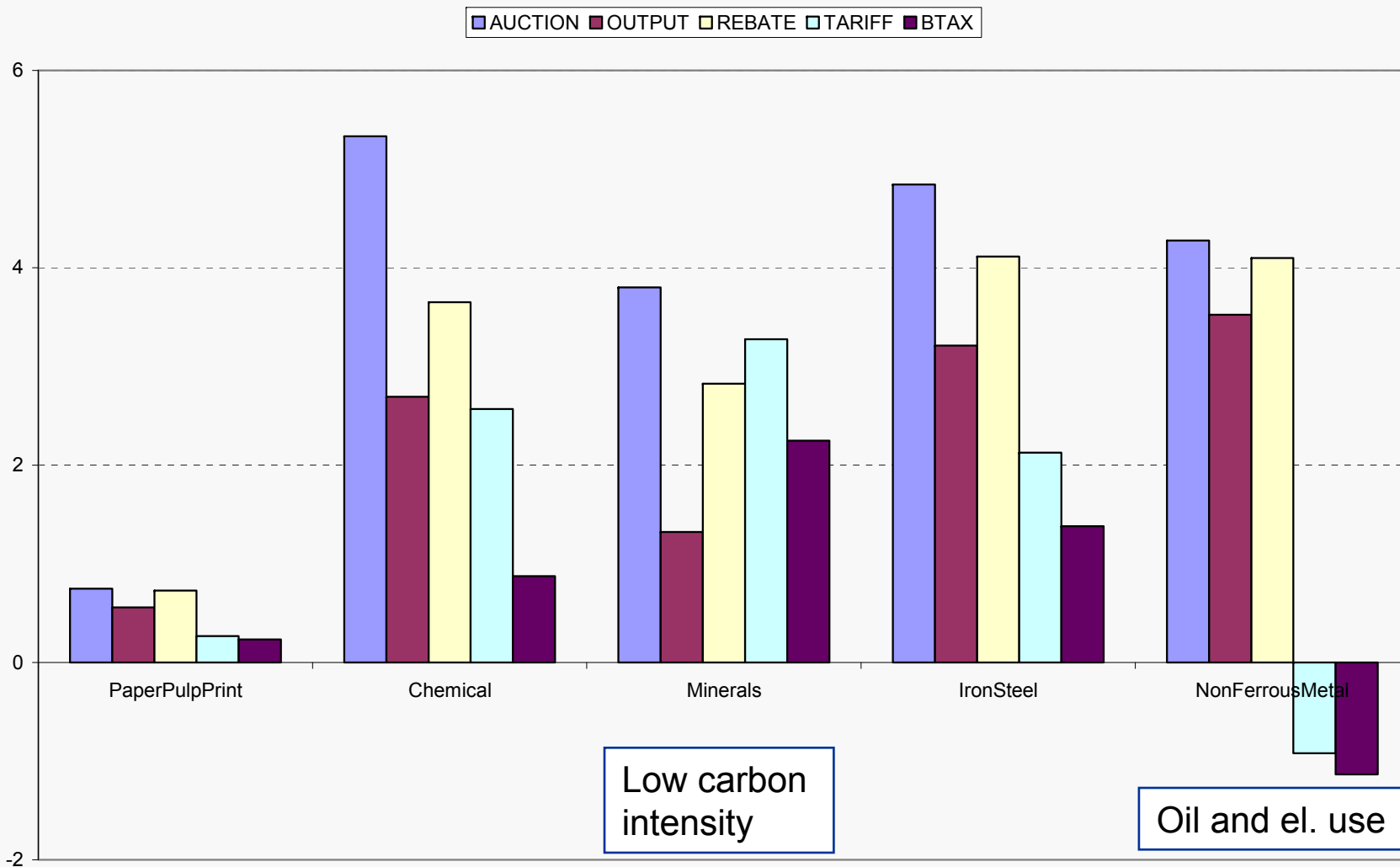


# Effects on Indian EITE exports of different U.S. and EU climate policies





# Effects on Brazilian EITE exports of different U.S. and EU climate policies







## Summary: Welfare

- Welfare effects of subglobal climate policies are significant not only for the countries undertaking them but also for their trade partners
  - Mostly negative, but some winners
- Policies intended to avoid leakage have little effect on welfare overall – even in the countries implementing them
  - Mainly shift global production in certain energy intensive goods.
- However, import adjustments can have significant effects for fossil fuel producing nations.



## Summary: Leakage

- Significant share occurs via changes in global energy prices
- None of the countervailing policies are able to reduce leakage rates very much – at most by 15%, in the case of full border adjustments
- 30-50% of leakage from U.S. and EU climate policies can be attributed to other Annex B nations.
- Adjustment policies do have significant effects on the energy intensive sectors to which they are applied.
- Still, for the most part, domestic production is lower and foreign exports are higher than without any climate policy intervention.
  - Exception for cement and glass for some exporters.



# Sensitivity Analysis

- Specific plans:
  - Leakage compensation (fixed global emission reduction)
    - ◆ EU welfare effects more differentiated
  - Energy supply elasticities
  - Trade elasticities
  - EITE coverage (e.g., refineries)
  - Targets
  - ??



## Some conclusions

- Main effects on global welfare, emissions, and leakage arise from the primary climate policies themselves
- Developing nations do not actually gain economically from developed country efforts to reduce GHGs.
- Nor do their sectors targeted specifically by anti-leakage policies necessarily lose, compared to a world without any climate policies.
- Ultimately, it is in all countries' interest to mitigate climate change as comprehensively and cost-effectively as possible
  - The larger question is whether or not unilateral anti-leakage policies can help in that transition.



# EC Implementation (1)

- Economic implications of unilateral Canadian climate policies without US action
  - Ex-post justification for Kyoto compliance problems?
  - Specific protection policies for EITE (border measures and trade allowance allocation)
- Domestic/international emission reduction policies:
  - EU only (scenario: EUR)
  - EU and Canada (scenario: EUR\_CAN)
  - EU and Canada and the USA (scenario: EUR\_CAN\_USA)
- Issues addressed:
  - Importance of US “comparable effort” for economy-wide and sectoral implications of unilateral climate policies in Canada
  - Effectiveness of border measures or output-based allocation measures for welfare, EITE output (“competitiveness”) and leakage



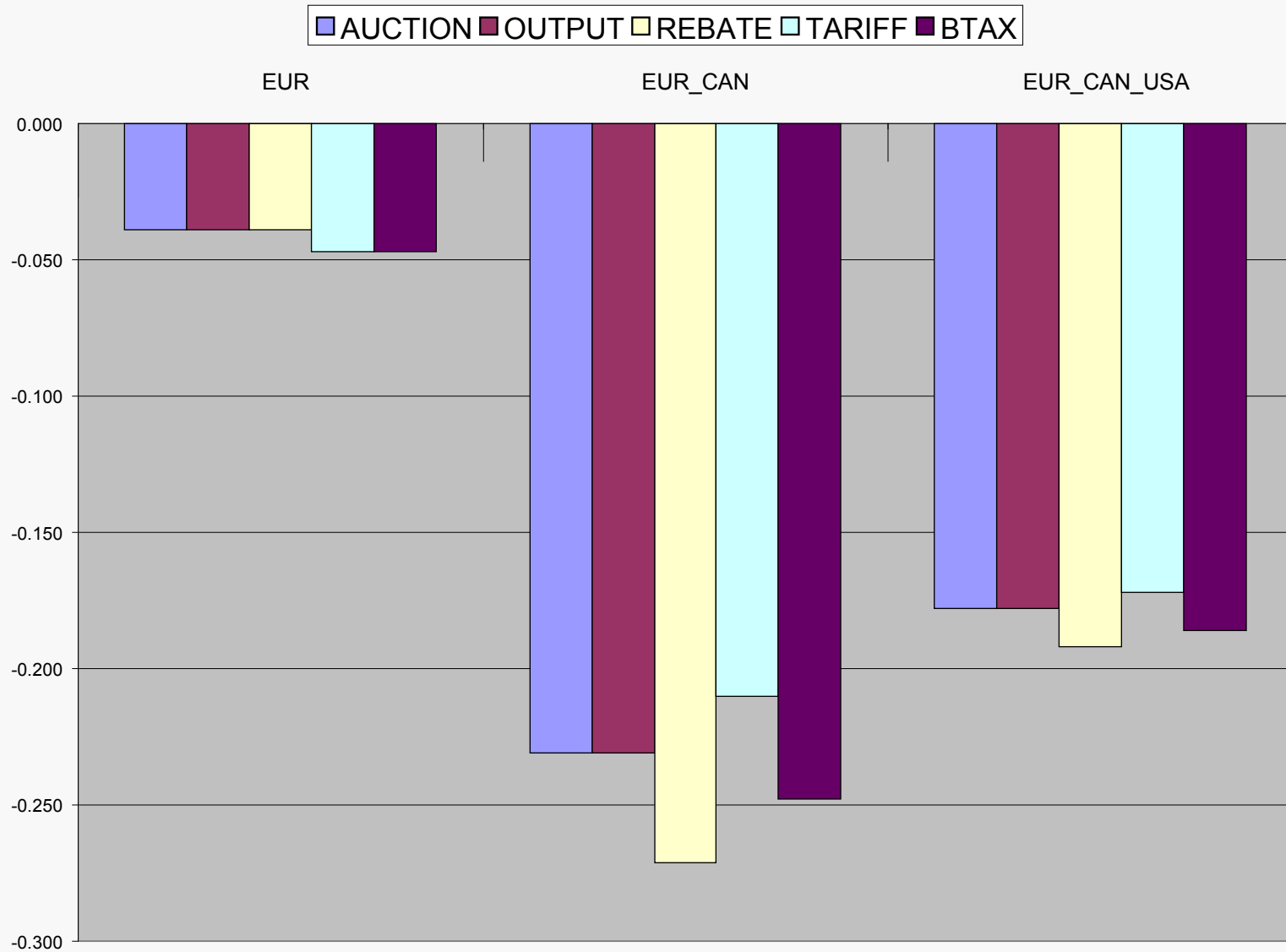
# EC Implementation (2)

- Leakage argument:
  - Need for leakage adjustment towards constant global effectiveness
  - Leakage adjustment through proportional scaling of domestic reduction targets

N.B.: By default there is no leakage adjustment.
- Robustness of policy conclusions:
  - Inclusion of embodied carbon for electricity (default: only direct carbon)
  - Fuel supply elasticities (default: coal=4; oil/gas=1)
  - (Armington) trade elasticities → empirical estimates beyond GTAP
  - Stringency of policy target (default: 20%)
  - Coverage of EITE sectors (e.g. inclusion of refined oil products)
- [Application to 2020 forecast]



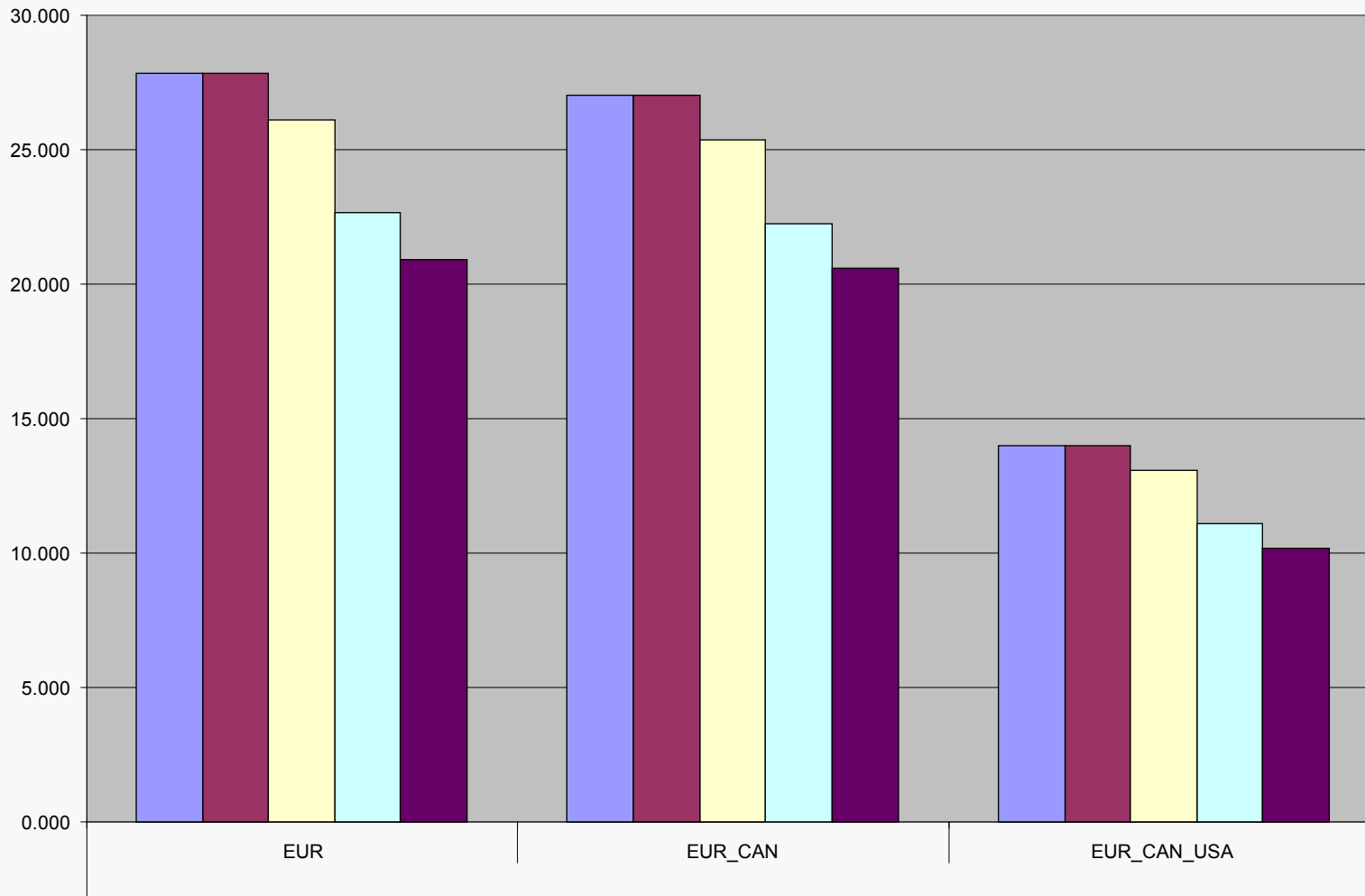
# Welfare impact for Canada





# Global leakage rates

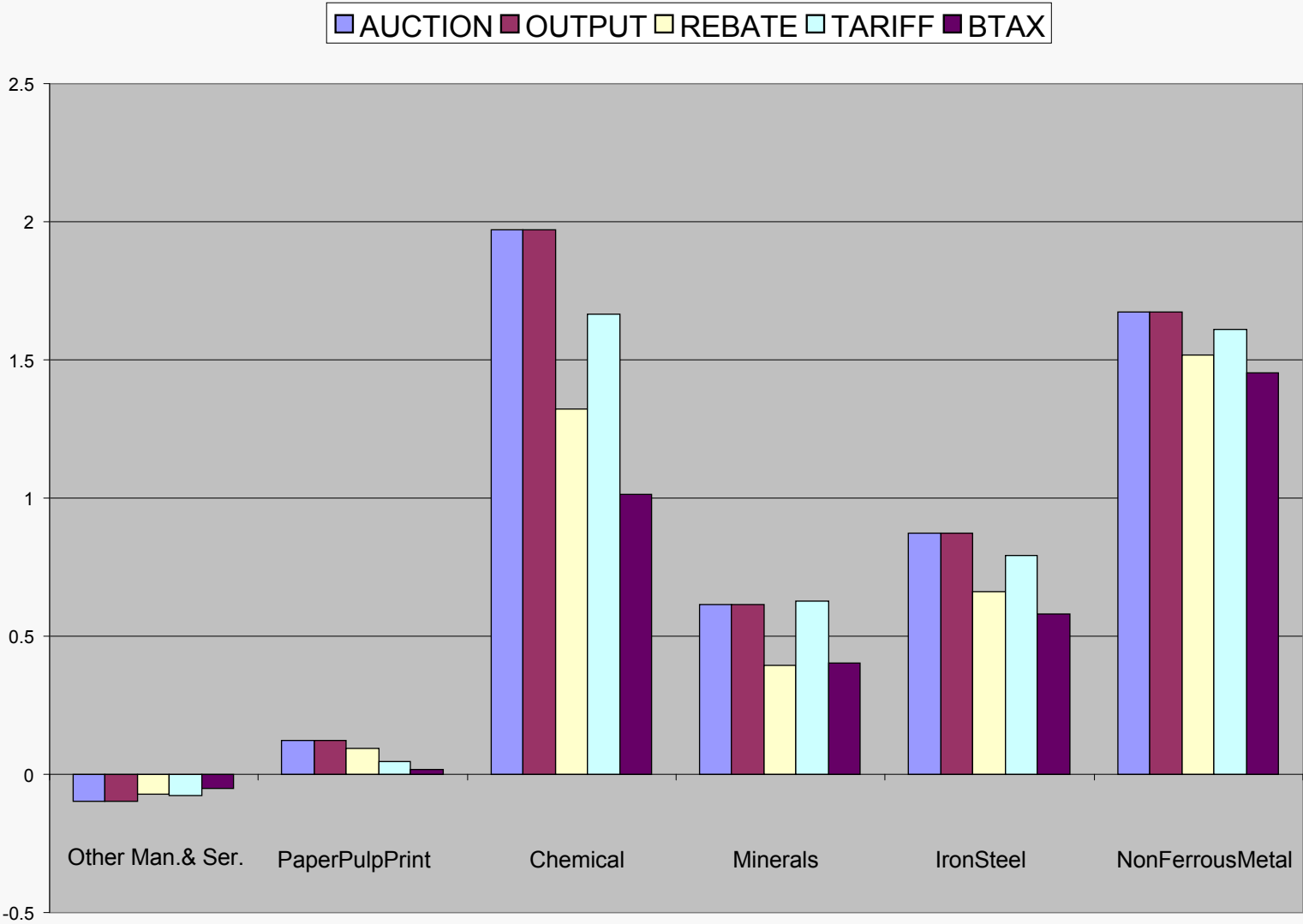
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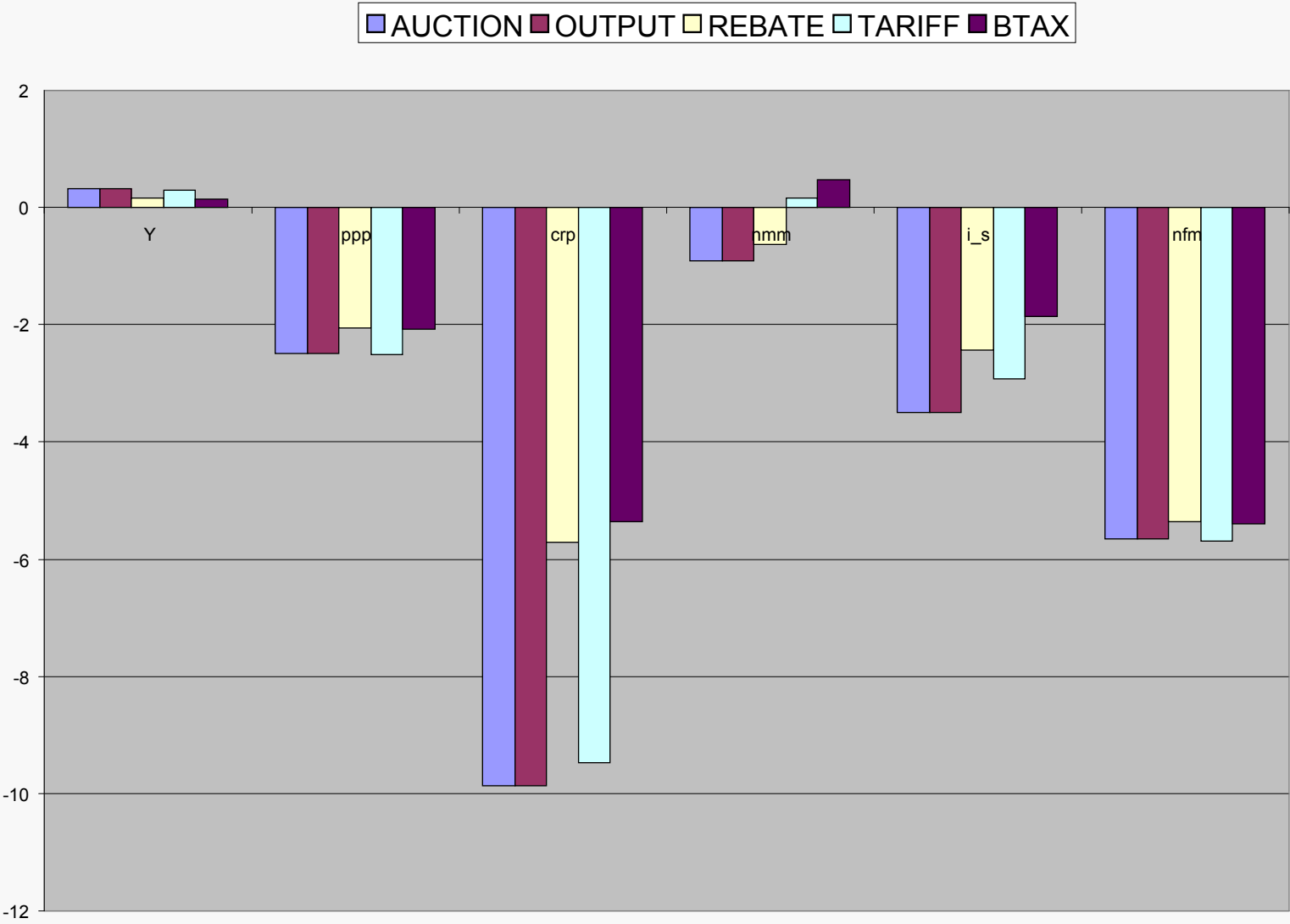


# EUR: Effects on Canadian production





# EUR\_CAN: Effects on Canadian production





# EUR\_CAN\_USA: Effects on Canadian production

