

Sustainable Development and the General Equilibrium Approach

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How to Assess the Environmental Impacts of Trade Liberalization

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Outline

- Trade and environment linkages
 - Economic mechanisms
 - Needed framework
 - Data and model requirements
- Economic integration in the Western Hemisphere

Economic mechanisms

- International distribution of industries
- Industrial composition of national output
- Intensity of production
- Consumers' demand for environmental quality

A framework which

- Covers international linkages through trade
- Captures economy-wide resource competition
- Models input-output relationships with production functions
- Explicitly incorporates environmental quality into consumers' utility functions

Trade and environmental impacts of economic integration in the Western Hemisphere

- Summit of the Americas, Miami, Dec. 1994
 - Reduce trade and investment barriers
 - Improve environmental quality
- Simulations
 - Free Trade in Western Hemisphere
 - WH Free Trade + Environmental Policy
 - Harmonization in Mexico, Brazil, Argentina*

Regional, Sectoral Specification

Regions

- Canada
- United States
- Mexico
- Argentina
- Brazil
- Other Latin America
- Other Developed Economies
- Rest-of-the-World

Sectors

- Grains
- Non-grain Crops
- Livestock
- Resource Based Industries
- Meat Products
- Milk Products
- Beverages and Tobacco
- Other Food Products
- Clothing and Textiles
- Chemicals and Metals
- Final Manufacturing
- Services

GTAP model additions

- Pollution is proportional to output
- Abatement activities financed by environmental taxes
- Environmental endowment from which net pollution is deducted
- Environmental endowment enters households' utility function, thereby generating benefits

Pollution Emissions

- $QPOL_{k,j,r} = A_{k,j,r} \times QO_{j,r}$
 - k : Erosion, Other Pollution
 - j : Sectors
 - r : Regions

Land set aside

- $QO_{Land, r} = CET(QFE_{Land, Conservation, r}, QFE_{Land, Agriculture, r})$
- $QFE_{Land, Agriculture, r} = CET(QFE_{Land, j, r})$
- $VLandTax_r = \sum \tau f_{Land, j, r} \times PMES_{Land, j, r} \times QFE_{Land, j, r}$

Environmental Policies and Pollution Abatement

- $VAB_r = \sum \tau e_{j,r} \times PM_{j,r} \times QO_{j,r}$
- $QO_{Pollution\ Cleaning, r} = VAB_r / PS_{Pollution\ Cleaning, r}$

Net Pollution, Environmental Quality, and Welfare

- $QNP_r = \sum QPOL_{Erosion,j,r} + \sum QPOL_{Other,j,r} - QO_{Pollution\ Cleaning, r}$
- $EQ_r = END_r - QNP_r$
- $U'_r = CES(U_r, EQ_r)$

Data

- Agriculture (20% of US pollution damage)
 - Soil erosion
 - Pesticide toxic releases
 - Nitrogen releases by livestock
- Industry (80% of US pollution damage)

Other regions

Extrapolate to Canada, Mexico, Brazil and Argentina assuming:

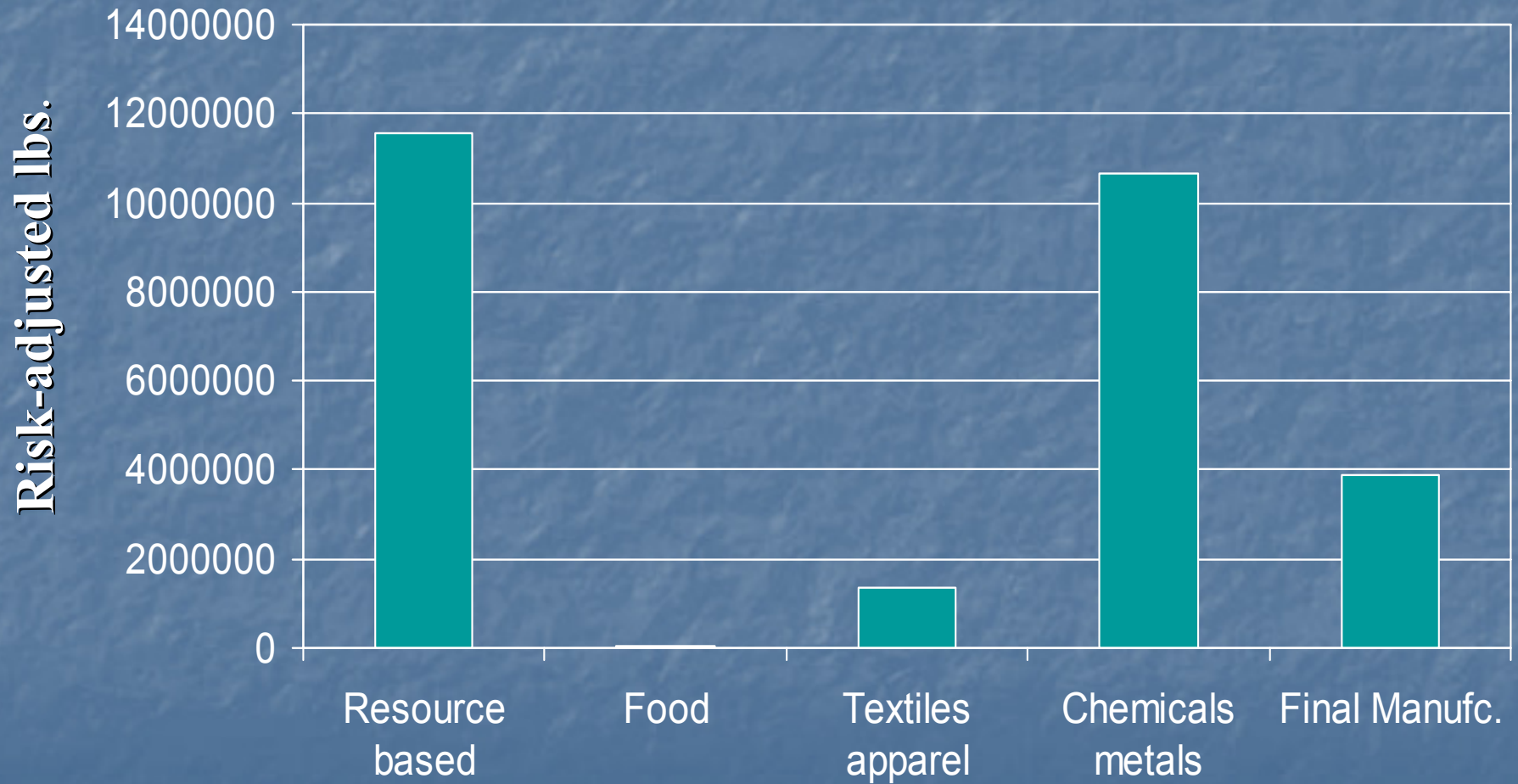
- erosion proportional to value of crop output
- pesticide pounds per acre equal
- nitrogen emissions per animal the same
- industrial releases proportional to value of output

Benchmark Environmental Data

Pollution Emissions

	Canada	USA	Mexico	Argent.	Brazil
Soil Erosion, 1,000 tons					
Grains	138,885	1,106,790	196,877	96,725	275,274
Non-grain Crops	89,536	675,410	196,863	200,994	274,344
Pesticide Toxic Releases, mill. Lbs					
Grains	51	854	335	54	611
Non-grain Crops	14	405	49	91	163
Nitrogen Releases, 1,000 lbs					
Livestock	1,856	16,211	4,687	6,925	21,228
Industrial Toxic Releases, lbs					
Resource Based Industries	1,517,370	11,554,900	499,190	588,704	927,089
Meat Products	7,329	45,499	9,889	6,264	8,630
Milk Products	18,575	107,674	4,611	12,217	14,210
Beverages and Tobacco	5,234	46,152	4,923	7,889	5,274
Other Food Products	35,863	333,233	44,288	38,222	48,281
Clothing and Textiles	181,725	1,371,640	161,470	246,289	336,754
Chemicals and Metals	1,240,670	10,673,300	818,583	995,859	1678,970
Final Manufacturing	419,403	3,902,930	134,574	125,112	289,145

U.S. Industrial Toxic Releases



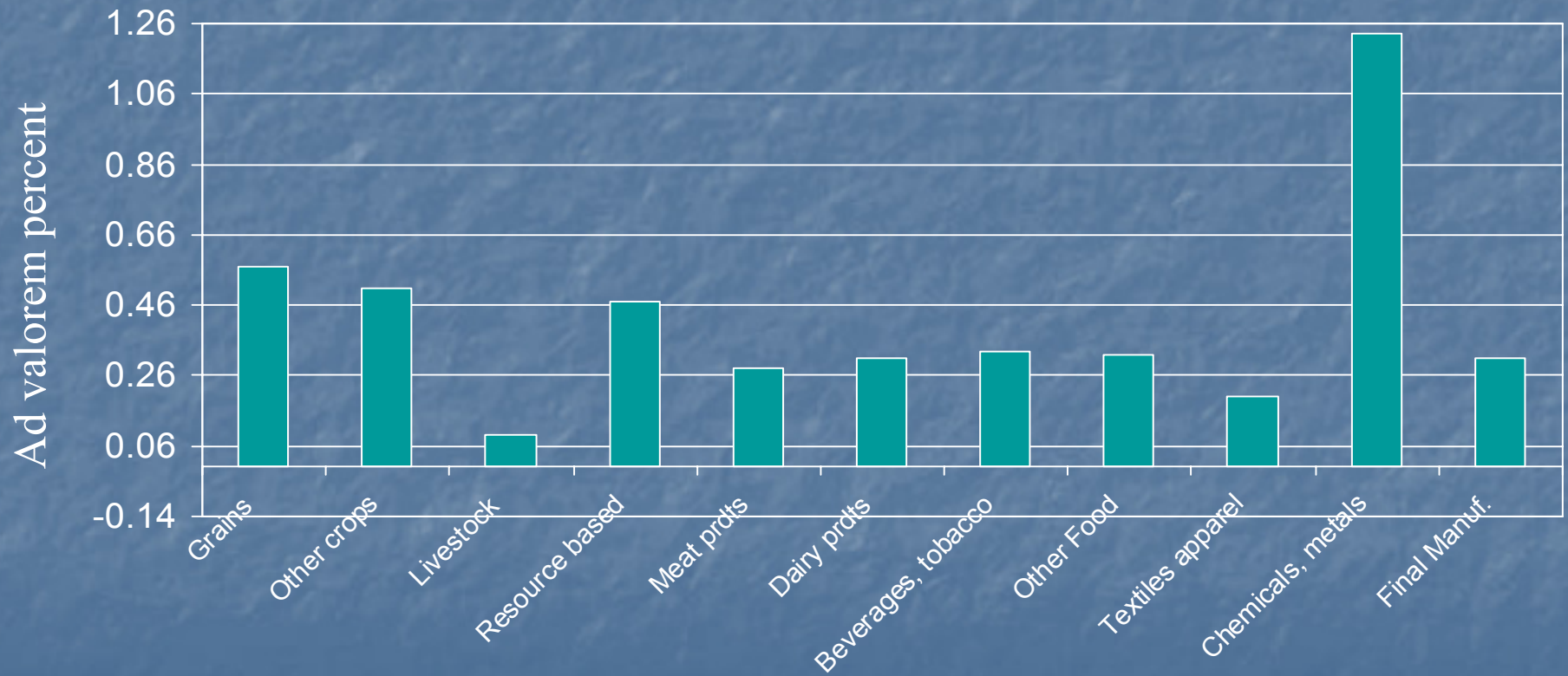
Source: World Bank, IPPS

Benchmark Environmental Data

Pollution Abatement Expend., US \$ mil.

	Canada	USA	Mexico	Argent.	Braz
Land Conservation Expend.					
Grains	114.8	1087.5			
Non-grain Crops	80.5	721.6			
Abatement Expenditures					
Grains	20.3	404.2			
Non-grain Crops	10.5	373.3			
Livestock	8.7	89.9			
Resource Based Industr.	518.2	4689.1			
Meat Products	30.1	222.2			
Milk Products	21.2	146.2			
Beverages and Tobacco	25.3	265.3			
Other Food Products	64.5	711.8			
Clothing and Textiles	34.5	309.7			
Chemicals and Metals	787.4	8050.5			
Final Manufacturing	277.7	3071.6			

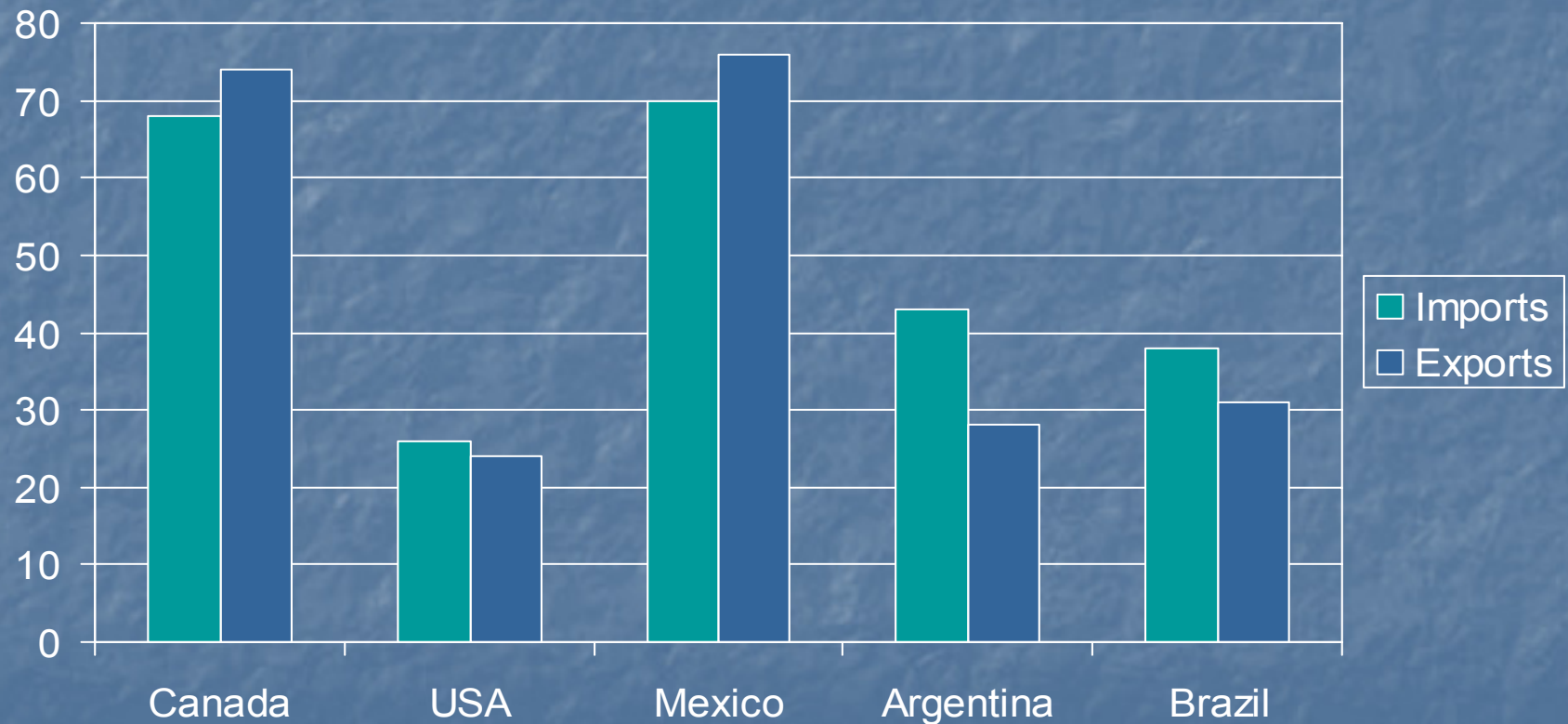
U.S. Environmental Tax Rates



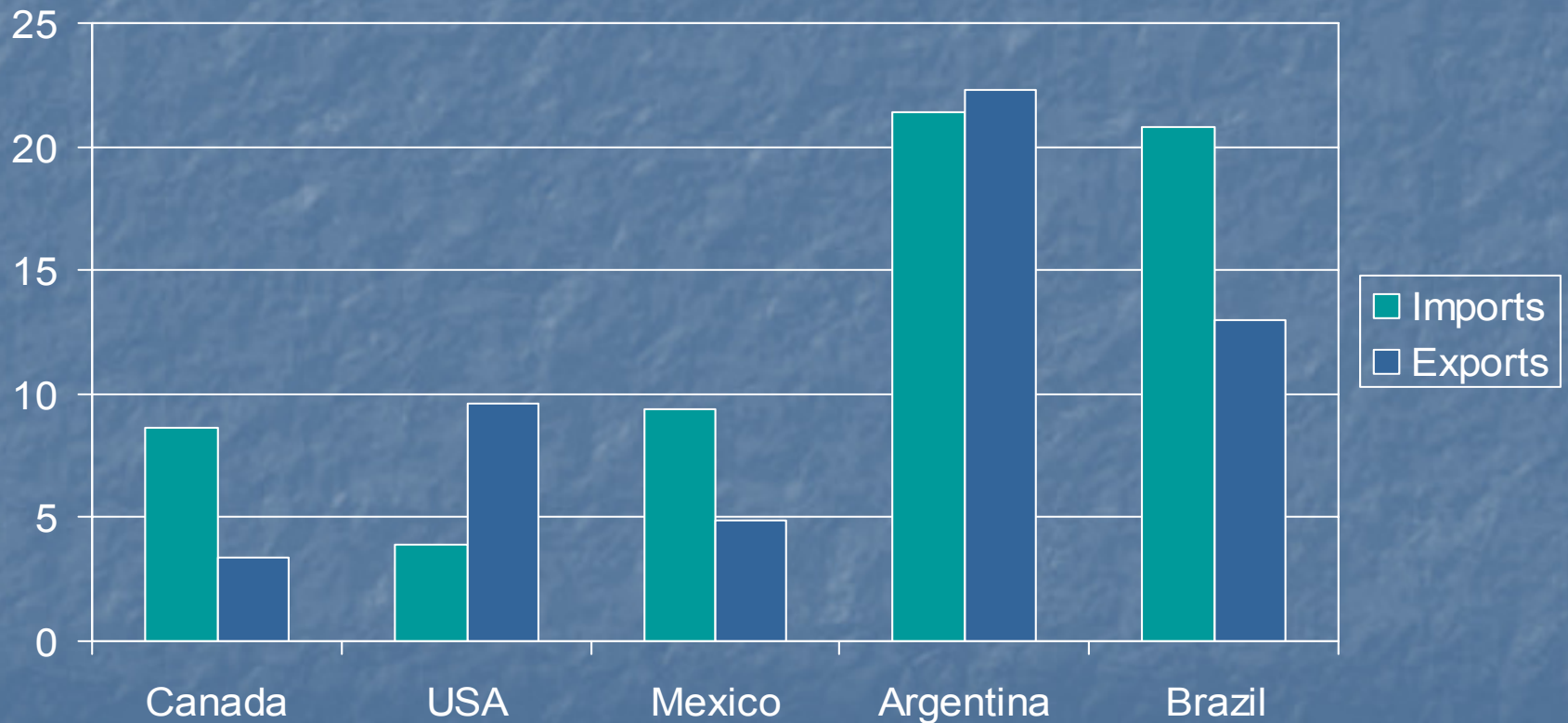
Policy Simulations

- (I) Free Trade in Western Hemisphere
Elimination of Import Tariffs Between Canada, USA, Mexico, Argentina, and Brazil
- (II) WH Free Trade + Environmental Policy *Harmonization*:
 - (II.A) Absolute Harmonization: Argentina, Brazil, and Mexico Impose Environmental Regulations that Duplicate U.S. Standards
 - (II.B) Relative Harmonization: Argentina, Brazil, and Mexico Impose Environmental Regulations Similar to U.S. Standards but Adjusted for their Own Valuation of the Environment

WH Total Trade Intensities

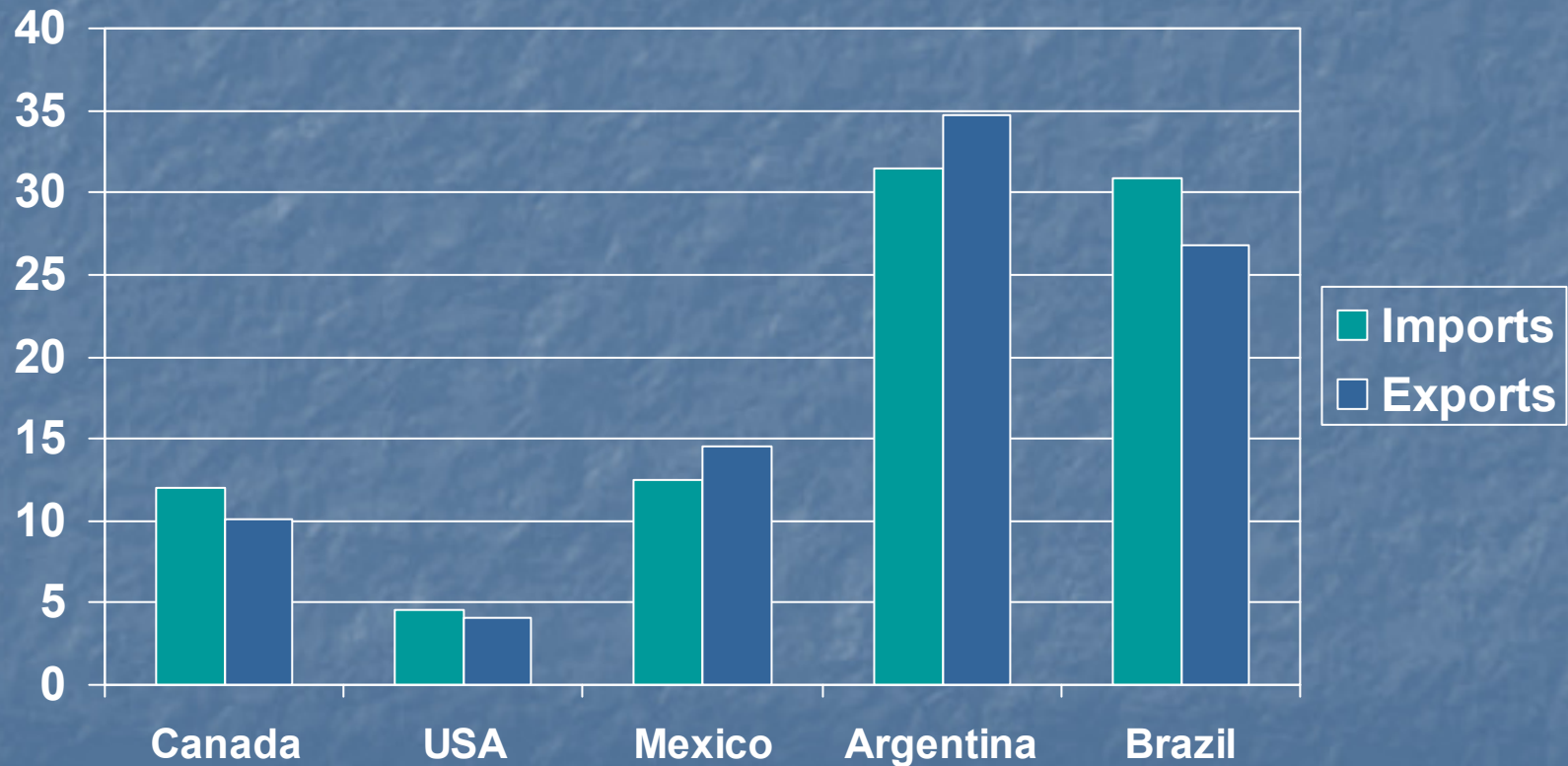


WH Trade Barriers



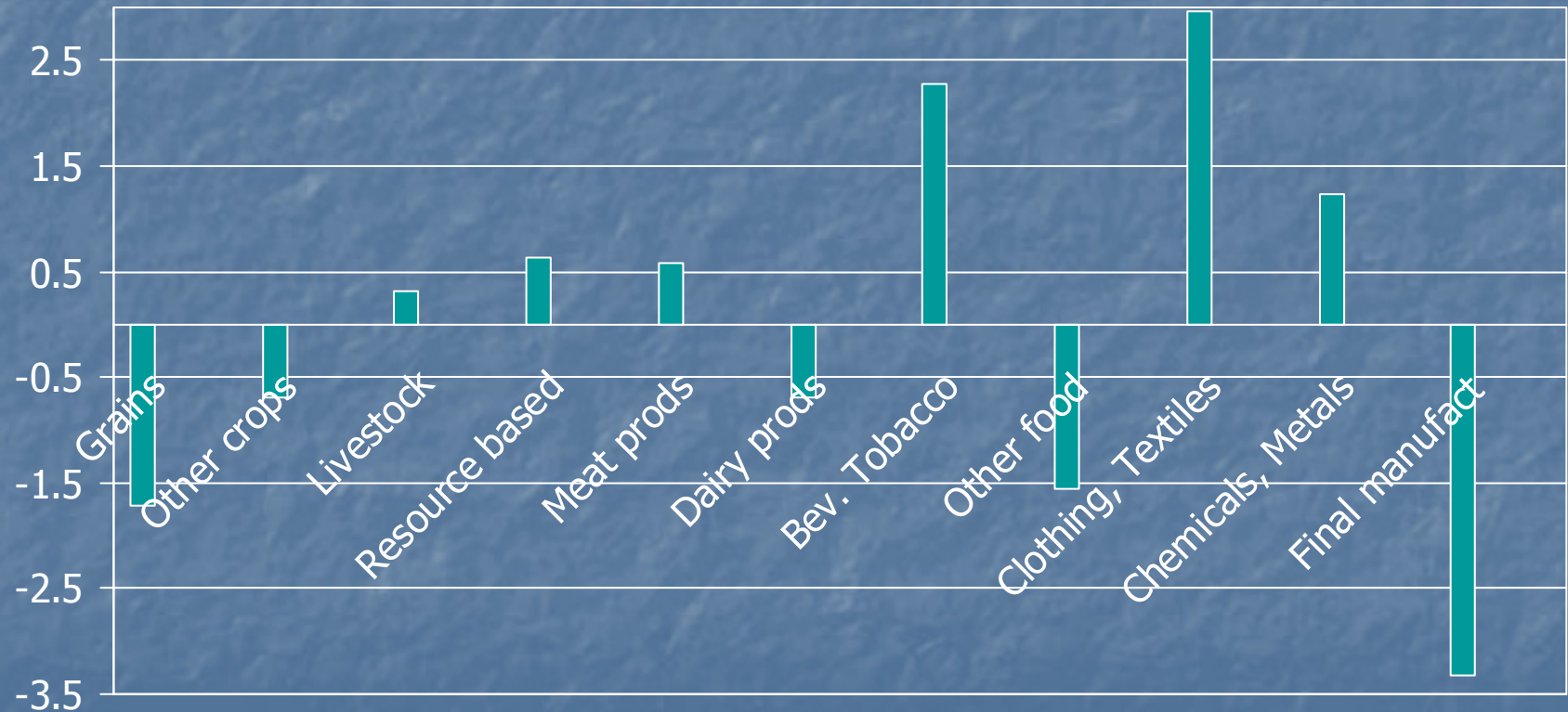
WH Free Trade

Impact on Total Trade Volume

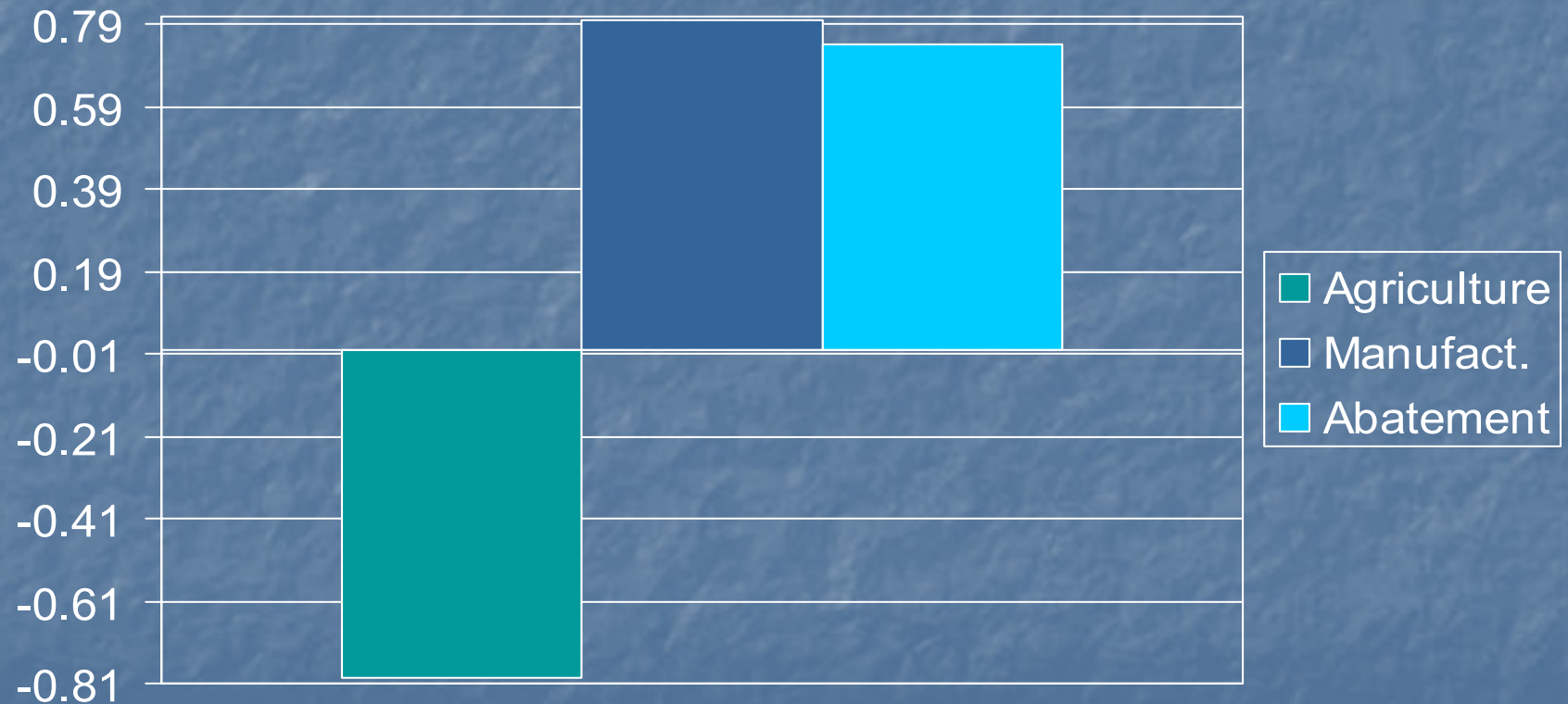


WH Free Trade

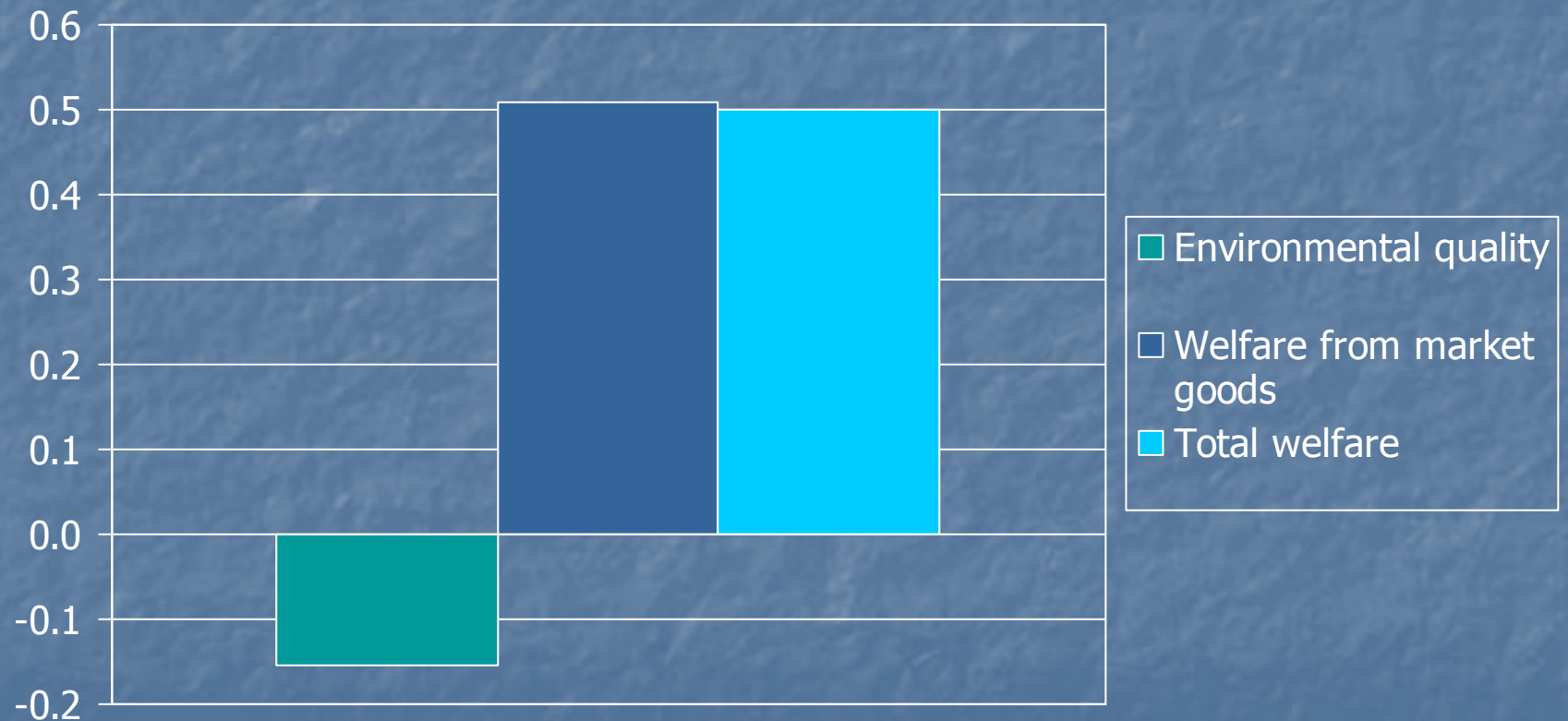
Impact on Sectoral Output in Brazil



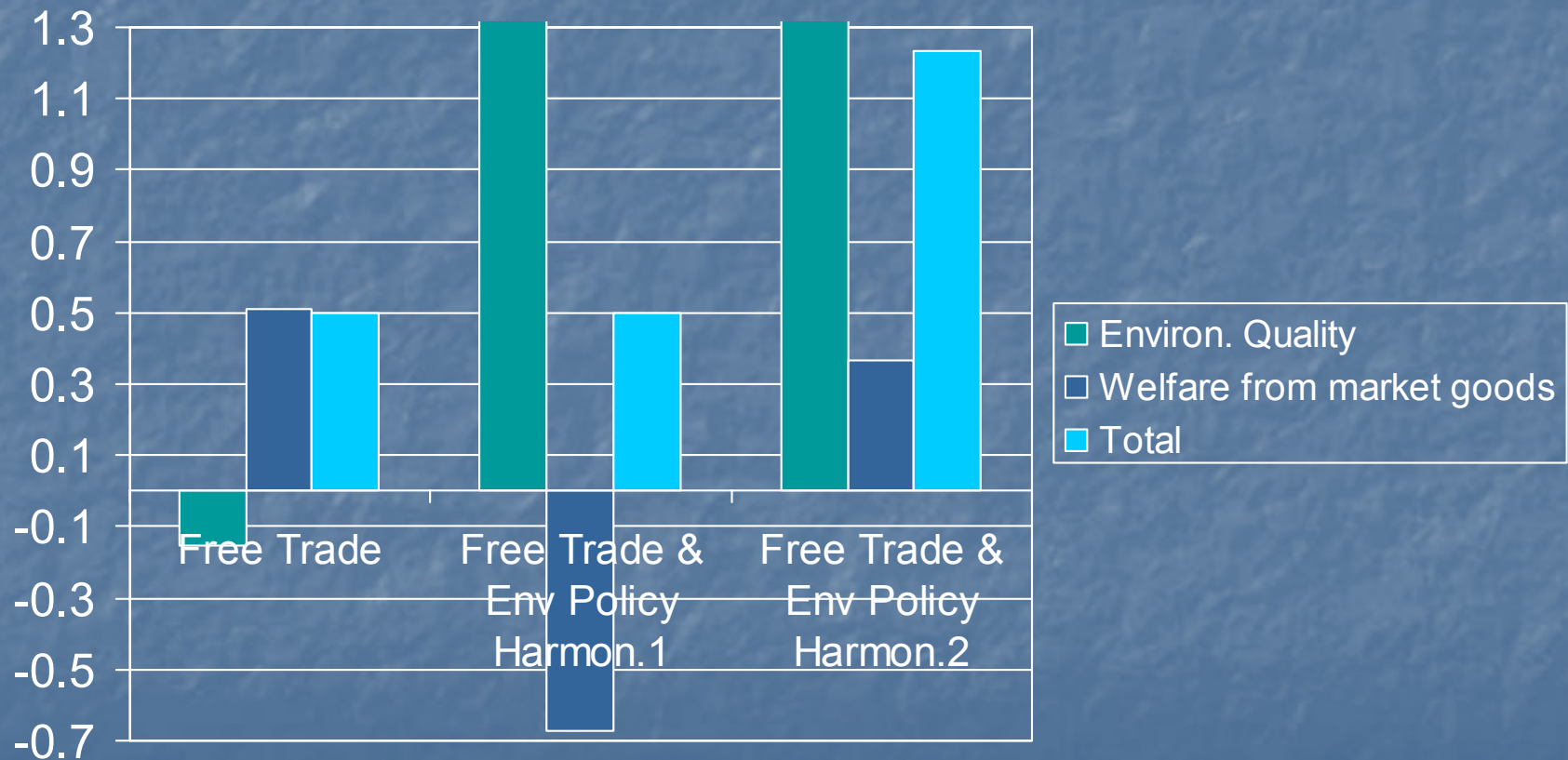
WH Free Trade Impact on Pollution in Brazil



WH Free Trade Welfare Impact in Brazil



WH Free Trade + Environmental Policy Harmonization Welfare Impacts in Brazilian



Economic integration in the Western Hemisphere

- Free Trade
 - beneficial for all participating countries
 - despite a decline in environmental quality in Mexico and Brazil
- Free Trade + Relative Environmental Harmonization
 - increases free trade gains and total welfare for Mexico, Brazil, and Argentina
- Free Trade + Absolute Environmental Harmonization
 - diminishes free trade gains for Mexico, Brazil, and Argentina