DISAGGREGATE DISCOUNTING IN THE CONTEXT OF CLIMATE CHANGE ECONOMICS: THE POLICY IMPLICATIONS OF GLOBAL ASYMMETRIES

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*** The views expressed are those of the authors and do not necessarily reflect those of the organization with which they are affiliated. Please send comments to yanchun.zhang@undp.org**

Why do we care about discounting?

- Economics of climate change often deals with trade-offs across generations.
- Given that discounting takes place over many years, even relatively small differences in the discount rate can have a very large impact on the assessment.
- High social discount rates favor a "ramp-up" approach to mitigation; while low discount rates favor more immediate large-scale action.

Why do we care about asymmetry?

- The world is not composed of a single individual or a group of identical individuals.
- The world is not composed of a single goods or a basket of identical goods.
- Income distributions intersect with climate change at two levels:
  - Causes of climate change: asymmetries in contributions to the current GHG stocks; emission paths into the future.
  - Effects of climate change: the poorest countries and people suffer the most.

Differences in CO_2 Emissions Across Groups of Countries in 2004

Data refers to CO_2 emissions only. Total greenhouse gases emissions can be between 10% and 40% higher.

	CO2 emissions (Mt CO2)		CO2 emissions per capita (t CO2)	
	From fossil fuels, gas flaring and cement production	Including changes in forest biomass	From fossil fuels, gas flaring and cement production	Including changes in forest biomass
High income OECD	12,255	11,296	13.1	12.1
High income oil prod.	610	609	20.3	20.2
Middle income	12,125	15,448	4.0	5.1
Low income	2,003	3,128	0.9	1.4

Source: Own Calculations based on Human Development Report 2007/2008 and WDI data.
Note: **Emissions from changes in forest biomass are volatile**. Calculations assume that emissions from deforestation in 2004 were equal to the mean yearly emissions for the 1990-2005 period. High income oil producers correspond to high income OPEC members.

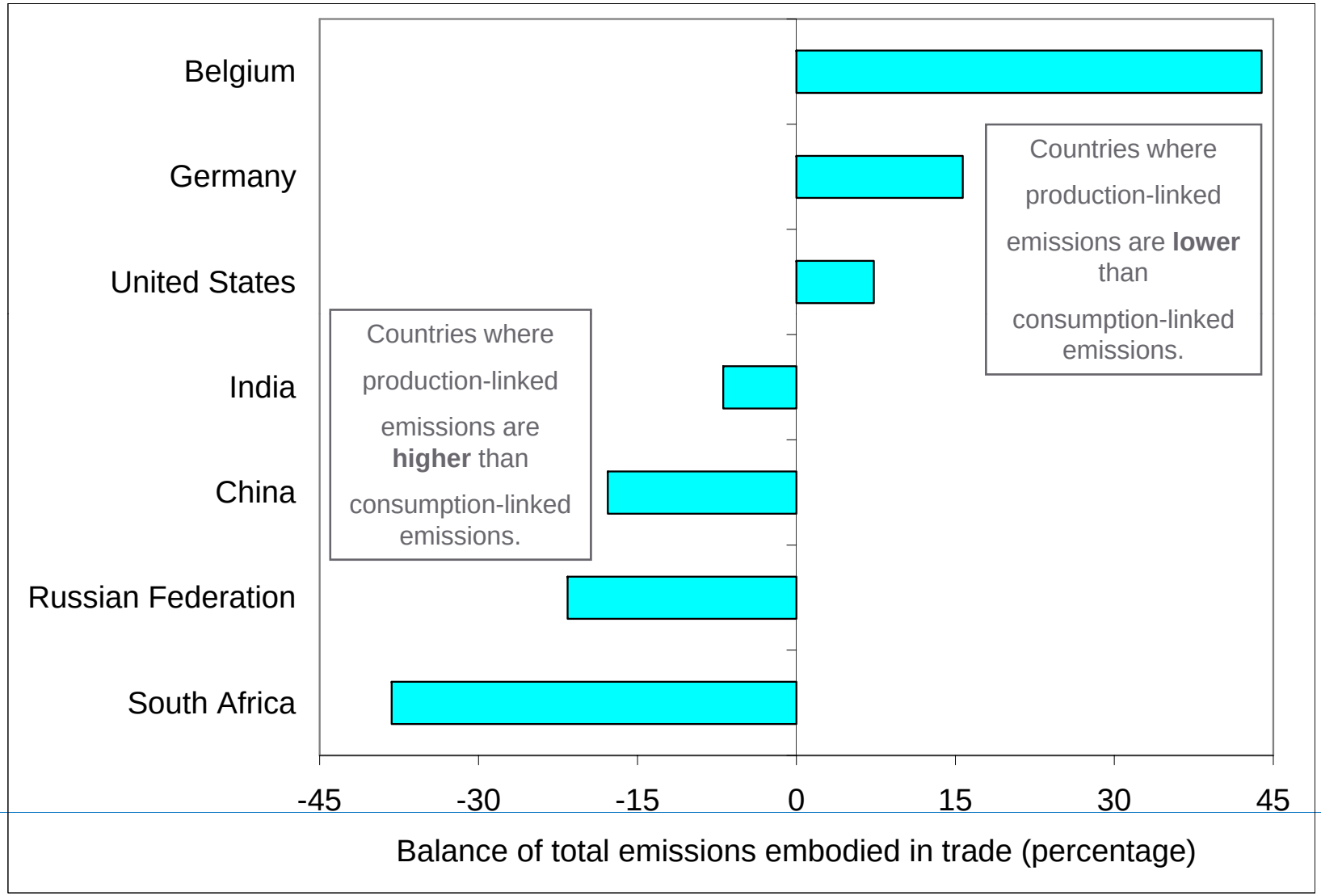
Differences in CO_2 Emissions Across Selected Countries in 2004

Data refers to CO_2 emissions only. Total greenhouse gases emissions can be between 10% and 40% higher.

	CO2 emissions (Mt CO2)		CO2 emissions per capita (t CO2)	
	From fossil fuels, gas flaring and cement production	Including changes in forest biomass	From fossil fuels, gas flaring and cement production	Including changes in forest biomass
United States	6,046	5,546	20.6	18.9
EU-15	3,242	2,968	8.4	7.7
Japan	1,257	1,139	9.8	8.9
Russian Fed.	1,524	1,596	10.6	11.1
China	5,007	4,672	3.9	3.6
India	1,342	1,301	1.2	1.2
Brazil	332	1,443	1.8	7.8
Indonesia	378	2,650	1.7	12.2
TOTAL	**19,128**	**21,315**		

Source: Own Calculations based on Human Development Report 2007/2008 and WDI data.
Note: Emissions from changes in forest biomass are volatile. Calculations assume that emissions from deforestation in 2004 were equal to the mean yearly emissions for the 1990-2005 period.

The Balance of Emissions Embodied in Trade Varies by Country



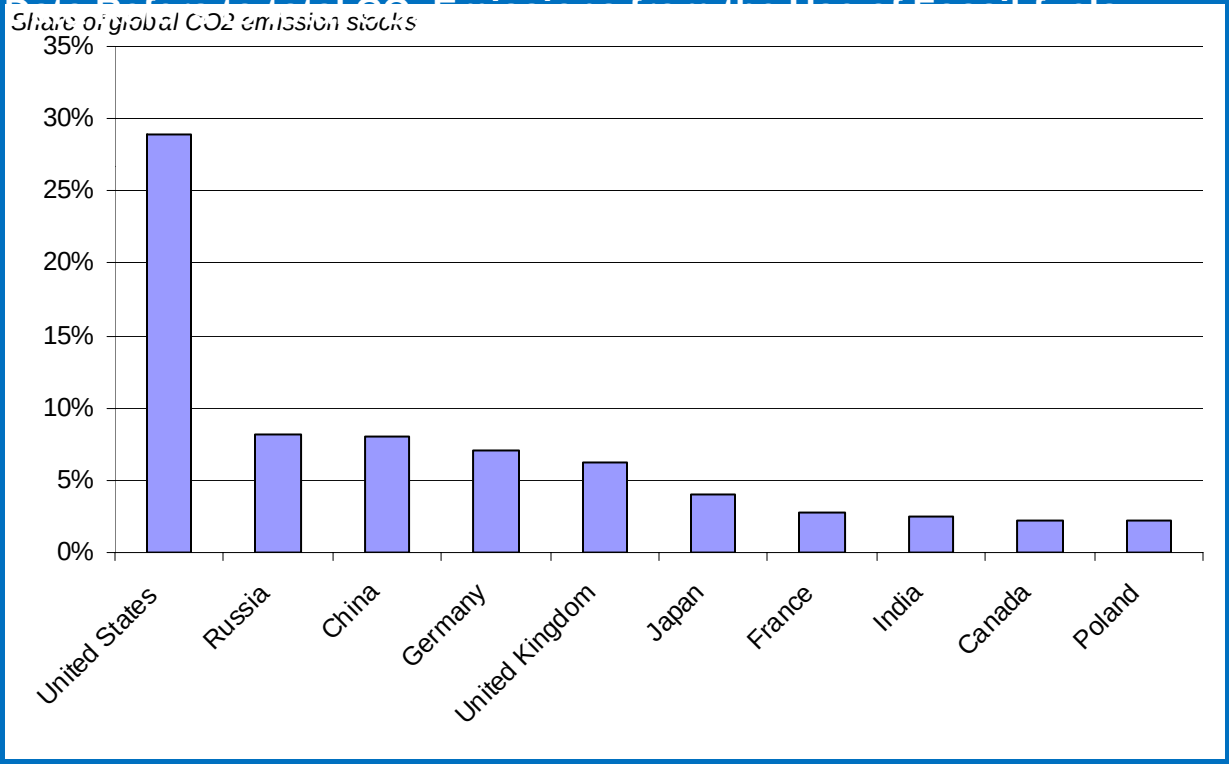
Source: Peters and Hertwich (2008). Data for 2001. Emissions exclude land use changes.

Emissions Embodied in Trade

- A significant issue quantitatively;
- Large variation in impact across countries due to differences in shares of trade;
- Production-based emission targets would favor high income countries;
- Consumption-based emission targets would favor developing countries and countries with large extractive industries.

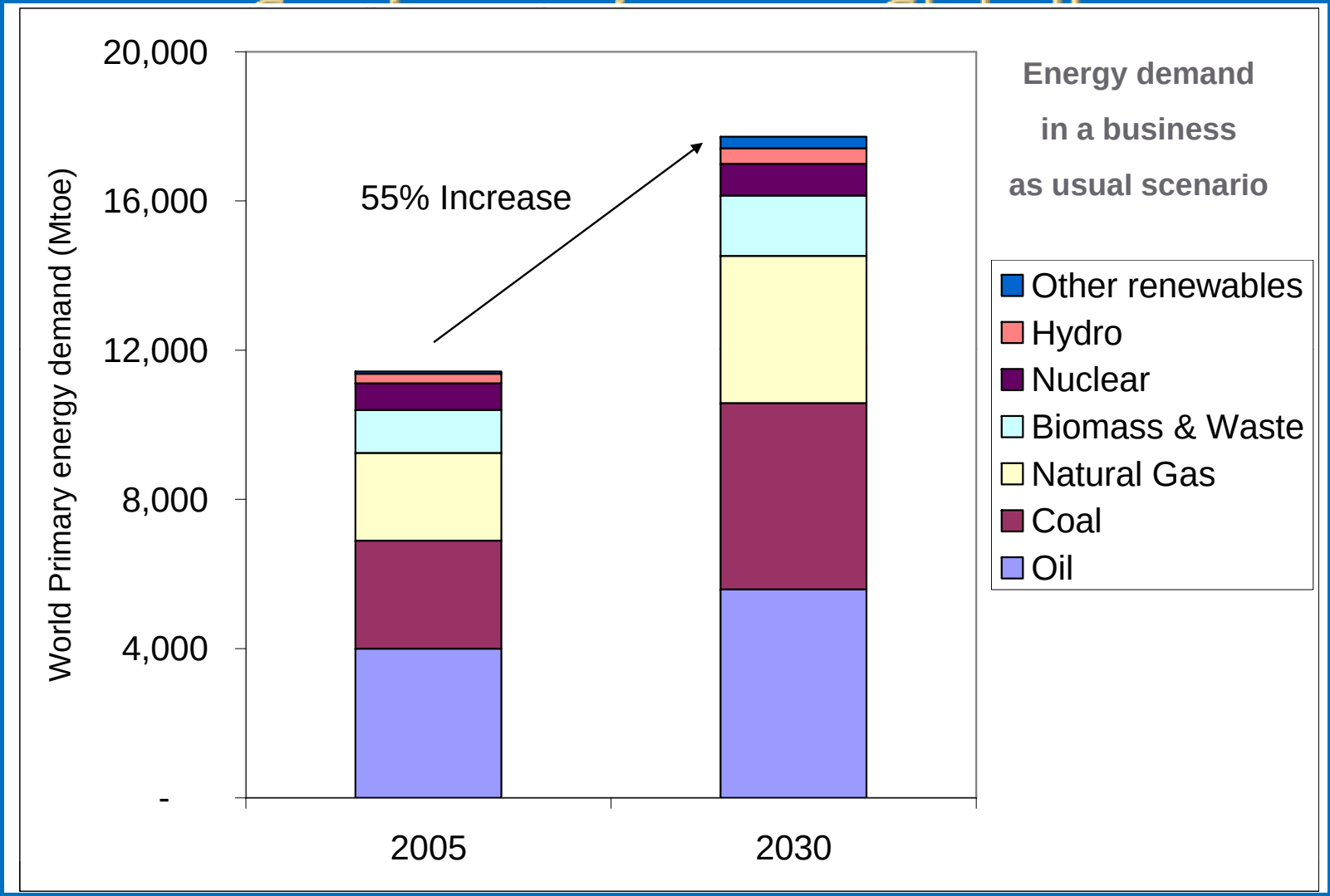
Contribution to Global CO_2 Stocks of Top 10 countries, 1840-2004

Approximately 2/3 of the accumulated CO_2 emissions in the atmosphere derive from developed countries.



Source: CDIAC 2007

…the World Primary Energy Demand will



Mtoe = Million tonnes of oil equivalent

Note: Includes power generation, other energy sectors and total final consumption.

Source: IEA 2007 (p. 74)

Dire Energy Needs in Developing Countries…

- Current energy services in developing countries fail to meet the needs of the poor:
  - 2.5 billion people rely on traditional biomass for cooking
  - 1.6 billion people do not have access to electricity.
- Wide disparity in energy use*, 2004:

Country	Kg of oil equivalent per capita
Benin	303
India	531
Angola	613
Brazil	1,114
China	1,242
Japan	4,173
Germany	4,218
Russian Federation	4,460
United States	7,920
Iceland	11,976

* Energy use refers to use of primary energy before transformation to other end-use fuels

Source: UN 2005, World Development Indicators online.

Discounting under certainty in a single world

- r is the social discount rate and is used to discount consumption;
- ρ is the pure time preference rate, and it is used to discount utility;
- η is the elasticity of marginal utility of consumption, measuring the relative curvature of the utility function—how quickly utility drops as consumption increases;
- g is the growth rate of consumption per capita).

Why do we care about asymmetry?

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- The world is not composed of a single goods or a basket of identical goods.

Discounting in an asymmetric world

- Accounting for inter-generational inequality;
- Accounting for intra-generational inequality;
  - Heterogeneity in the rate of pure time preference
  - Modifications to the elasticity of marginal utility of consumption
  - Population-weighted growth rate of consumption per capita
- Accounting for relative price change in environmental goods

Inter-generational asymmetries

- Inter-generational asymmetries argue for a more flexible relationship between the discount rates and the parameters, which implies a time-variant discount rate (often declining over time).
  - A lower "ethical" rate of pure time preference ρ .
  - A falling consumption growth rate per capita g over time with the threat of climate change, especially if we project global consumption growth rates using population weights instead of GDP weights,.

intra-generational asymmetries

- Various intra-generational asymmetries argue for lower discount rate because climate change will have a disproportionate impact on the poor.
  - Two extensions capture heterogeneity in the rate of pure time preference ρ.
  - Two extensions capture modifications in the elasticity of marginal utility of consumption η.
  - An alternative methodology to capture heterogeneity in the growth rate of consumption per capita g also suggests a lower discount rate.

Distinction of environmental goods from other consumption goods

- as time passes, environmental goods become relatively scarcer, and the relative price of environmental goods goes up. Rational utility-maximizing agents will substitute expensive environmental goods with relatively cheaper consumption goods.
- If the inter-temporal elasticity of substitution between environmental goods and other consumption goods is very low, it is possible for a time-variant discount rate considerably lower than the conventional discount rate.