

EXPANDED NATIONAL ACCOUNTS FOR THE ENVIRONMENT

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Outline of the presentation

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Motivation

General context

- “There appears to be no consensus about how to, and perhaps little inclination to, redesign the standard national accounts to incorporate externalities.” (Nordhaus, 2008)
- **“GDP does not account for the depreciation of assets, including the natural environment. As our primary measure of economic success, it therefore encourages us to pursue unsustainable economic growth and development”.** (Dasgupta Review, 2021)
- “Our mission is to provide independent high quality statistical information at European, national and regional levels and to make this information available to everyone for decision-making, research and debate.” (Quality Declaration of the European Statistical System, 2009)

Motivation

Not yet at the « end of the beginning »...

...despite a lot of literature and attempts at implementation. There are numerous reasons for this failure:

- ***Methodological and empirical difficulties***, especially in the field of environmental valuation (discounting, SP/RP econometrics, data, transferability...)
- ***Interactions with other debates*** within public economy (definition of sustainability) or within national accounting (other criticisms to GDP), or between the two areas (welfare vs revenue perspectives)
- ***Focus of existing studies on adjusted indicators (GDP or savings) and results*** about productivity or sustainability rather than on the construction of a comprehensive accounting system, from flows to stocks

What the paper does

Objective and core principle

- The paper develops an accounting framework to expand the national accounting system for environment in a consistent way, that:
 - Achieves consistency of the full sequence of economic accounts from the production account to the capital account
 - Clarifies the associated concepts of adjusted value added, GDP, income and savings
 - Achieves aggregation of the different accounts from the national to the global level (integration of transnational pollution or global public goods such as the climate)
- **Core principle: the production boundary for goods and services is extended to include (positive or negative) environmental (non-market) flows (pollutions; amenities; degradations or improvements of natural assets) ; consistently, the assets boundary is enlarged to include environmental assets (GHG concentration, ozone layer, ecosystems...).**

What the paper does

Comments

- The objective is not to reconsider the way in which national accounting describes market activities but simply to integrate non-market services and the natural assets that provide them into the national accounts. **Thus expanded aggregates do not mask the usual aggregates (for example usual GDP for the market dimensions of economic activities) but add an environmental component to them.**
- **Main principles of “National income and product accounts” are respected** (absence of double counting, structure and consistency of accounts, etc.) and more precisely: *valuation of outputs is independent of inputs; monetary prices are the metric for relative values ; outputs are valued at their marginal rather their total value; and these marginal values are derived wherever possible from observable transactions.*

What the paper does

Valuation of environmental services

- For goods and services whose production is associated with polluting emissions, market prices no longer reflect their value to society. The cost of the damage associated with these emissions must be deducted. Following Abraham and Mackie (2006), it is considered that such **production activities are producing goods but also harmful emissions, to be valued as negative outputs.**
- **Pigouvian valuation:** The price to be considered for (negatively) valuing pollution is therefore the marginal cost of the associated damage for all the economic agents impacted, i.e., the price they are willing to pay for a marginal effort to reduce pollution. Similarly, shadow prices of natural assets reflect the discounted benefits of an improvement of their stock.

What the paper does

Related literature

- The paper is (mainly) built on:
 - Nordhaus (2006) “Principles of National Accounting for Non Market Accounts”
 - Nordhaus (2008) “Issues in non-market accounting : pollution in theory and practice”
 - Muller et al. (2011) “Environmental Accounting for Pollution in the US Economy”
 - Muller (2014) “Environmental Benefit Cost Analysis and The National Accounts” (slides)
 - Utilitarian approaches to natural capital valuation (seminal academic work of Dasgupta and Mäler (2000), Mäler et al. (2008), Arrow et al. (2012))

What the paper does

« *Results* »

Types of questions addressed by this “accounts” approach (examples):

- Integration of environmental impacts at the different levels (global GDP vs structure of the value added by activities)
- Treatment of effective environmental pricing (ecotaxes or cap and trade mechanisms)
- Validity of the three approaches – value-added, final uses, revenues- equality for the computation of expanded GDP
- Definition of genuine savings

Construction of expanded national accounts in a closed economy

The core principle at work...

Sector	Power	Arboriculture
Production	-30	0
Intermediate Consumption	0	-20
Value added Total: -10	-30	+20

	« Production »	Intermediate use	Final consumption
SO ₂ emissions (Acid rains)	-30 (coal plants) ged=-(2+1).10u	-20 (arboriculture)	-10 Recr. Amenities /Health

Construction of expanded national accounts in a closed economy

Hypotheses and notations

2 types of pollution emitted during the production process in industries i :

- **pollution classified as “flow”** e_i , which does not degrade the atmosphere beyond the (annual) period considered; $\sum_i e_i = e$
- **pollution classified as “stock”** E_i , which **degrades atmosphere capital and other asset stocks (human, productive, natural)**; $\sum_i E_i = E$
- For sake of lisibility, we assume a strict partition between the two types of pollution:
 - flow pollution affects only current, final, and intermediate uses
 - ignoring current damages to intermediate uses, stock pollution degrades asset stocks

Supply		and Use Table			
Supply in Market Products	Taxes on Products	Intermediate Input Table Industries		Final Table CF	Uses I
		(j)	(k)		
(l)	ToP			.	.
Environmental Externalities Pollutions (-) Amenities (+)	Ecotaxes				
Pollutions $-ged = -\sum_i ned_i$ $-GED = -\sum_i NED_i$ Amenities	$-\tau.e$ $-T.E$	$-p_j.e$	$-p_k.e$	$-p.e$	$-P.E$

Production Accounts
.....(i).....
.
$EVA_i = -ned_i - NED_i - (-p_i.e)$ $GVA_i = VA_i + EVA_i$

$$GVA - (\tau e + TE) = VA - gedcf - GEDI$$

$$GY = Y - gedcf - GEDI = GVA + ToP - (\tau e + TE) = GR$$

Construction of expanded national accounts in a closed economy

Adjusted value-added of industries (no effective pricing)

Flow pollution

- p_j marginal cost of the present damage for industry j associated with an additional emission of flow pollution
- p marginal cost of damage to final consumption induced by an additional emission of flow pollution
- **The total costs of damage related to the emission e_i of flow pollution from industry i**

$$ged_i = \left(\sum_j p_j + p \right) \cdot e_i$$

Stock pollution

- P marginal (discounted) cost of present and future damage caused by an additional stock pollution emission
- **The costs of damage related to the emission E_i of stock pollution from industry i :**
 $GED_i = P \cdot E_i$

Adjusted value added of industry i :

$$GVA_i = VA_i - ged_i - GED_i + p_i \cdot e = VA_i + EVA_i$$

$$\text{with } EVA_i = -ged_i - GED_i + p_i \cdot e \text{ (emitted-received)}$$

Construction of expanded national accounts in a closed economy

Production and expenditure approaches

By summing over all industries i :

$$ged = \left(p + \sum_j p_j \right) \cdot e = gedcf + \left(\sum_j p_j \right) \left(\sum_i e_i \right)$$

with $gedcf = p \cdot e$ the valuation of final damage

$$GED = P \cdot \left(\sum_i E_i \right) = P \cdot E = GEDI$$

Adjusted value added of the economy: $GVA = VA - gedcf - GEDI$

Adjusted GDP with the production approach: $GY = GVA + ToP$

Adjusted GDP with the expenditure approach:

$$\begin{cases} GCF = CF - gedcf = CF - p \cdot e \\ GI = I - GEDI = I - P \cdot E \end{cases}$$

and adjusted GDP: $GY = Y - gedcf - GEDI$

Construction of expanded national accounts in a closed economy

Income and wealth

Adjusted income and savings

- Adding income “in kind” distributed without compensation: environmental amenities and pollution damage

$$\begin{cases} GR = R - gedcf - GEDI = GY \\ GS = GR - GCF = GY - GCF = GI \end{cases}$$

Wealth account

- **Expanding wealth to atmosphere capital KA :** $GK = p_{KP} \cdot K_P + p_{KA} \cdot KA$

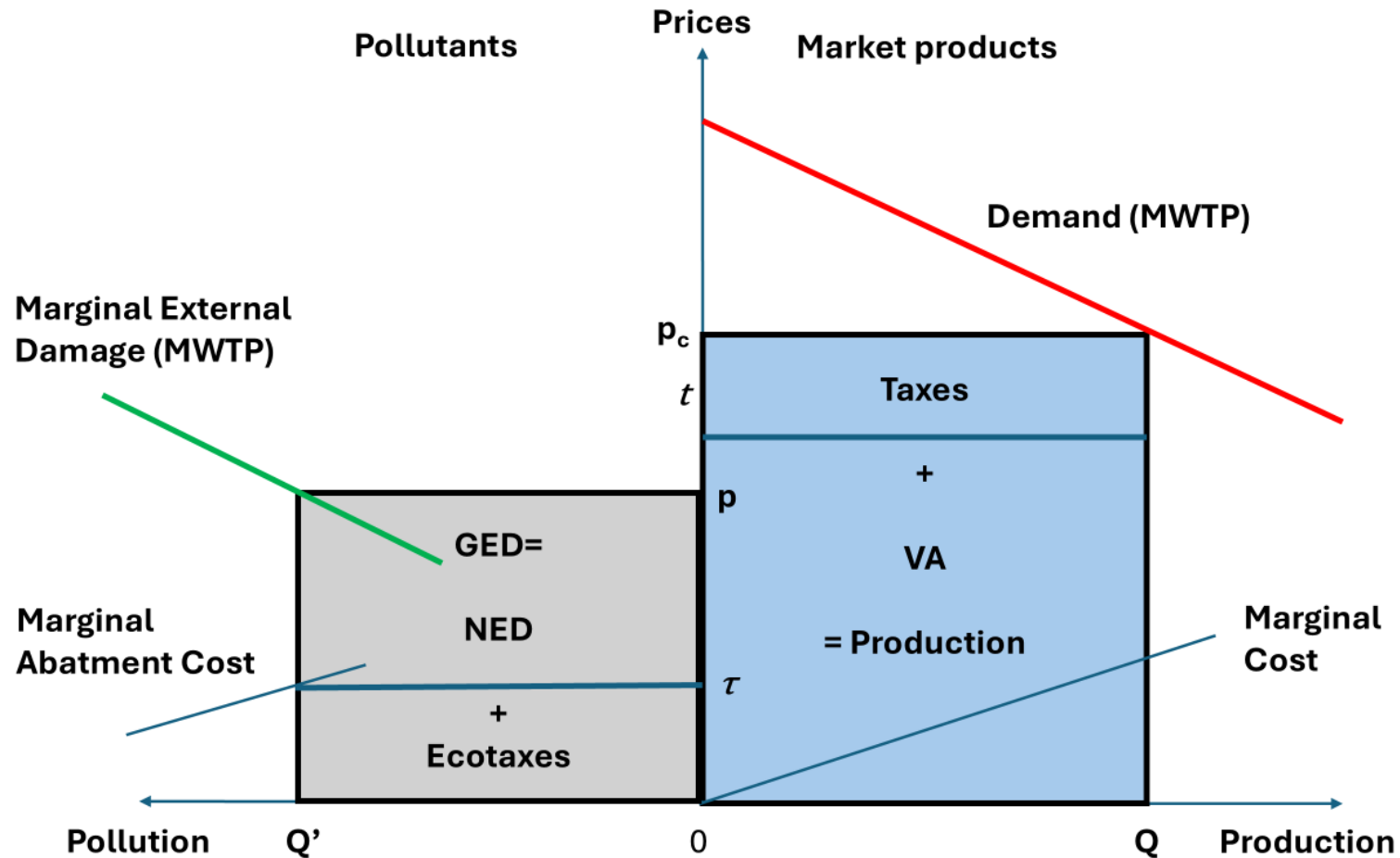
$$\Delta GK_{+1} = \Delta K_{+1} - GEDI + \text{non anthrop. impacts} + \text{real revaluation of } KA$$

In a closed economy (or an open economy without transboundary pollutions), valuing pollutions at their marginal cost, the three approaches to measuring production (adjusted GDP) coincide, and the adjusted savings derived from them is equal to adjusted investment

Construction of expanded national accounts in a closed economy

Understanding the treatment of the effective pricing of pollutions

Market and pollution « productions » Similarities and differences



Comments

- Ecotaxes or prices of permits reflect internalized marginal social costs
- Only their residual part is imputed to activities (NEDs)
- impacts on investment are negative (GHG) or positive (Carbon sinks)
- Demand side and in-kind adjustments of revenues unchanged

Open-economy with transboundary pollutions and global public goods/assets

Balance between received and emitted foreign damages

Y	CF	I	X	-M
$-p.e$	$-gedcf$		$-gedx$	
ged^*y	$-ged^*cf$			ged^*m
$-(P+P^*).E$		$-P.E$	$-P^*.E$	
		$-P.E^*$		$P.E^*$

$$EB = -gedx + ged^*m - P^*E + PE^* = -EB^*$$

Open-economy with transboundary pollutions and global public goods

Genuine savings : $-(P + P^*) \cdot E = -SCC \cdot E$ or $-P \cdot (E + E^*)$? i.e. emitted or received damages?

$$GY = Y - p \cdot e + ged^* y - (P + P^*)E$$

$$GR = GY + (gedx - ged^* m) + P^* \cdot E - P \cdot E^* = GY - EB$$

$$GS^Y = GY - GCF = S + (ged^* m - gedx) - (P + P^*) \cdot E$$

(Genuine savings of the country for all future generations)

$$GS^R = GR - GCF = S + GI - I = S - P \cdot (E + E^*) = GS^Y - EB$$

(genuine savings for the development of the country)

Open-economy with transboundary pollutions and global public goods

GDP/S adjustments (2024) for GHGs. MCD shares reflecting bottom-up models

$$GY - Y = -(P + P^*).E = GS^Y - S$$

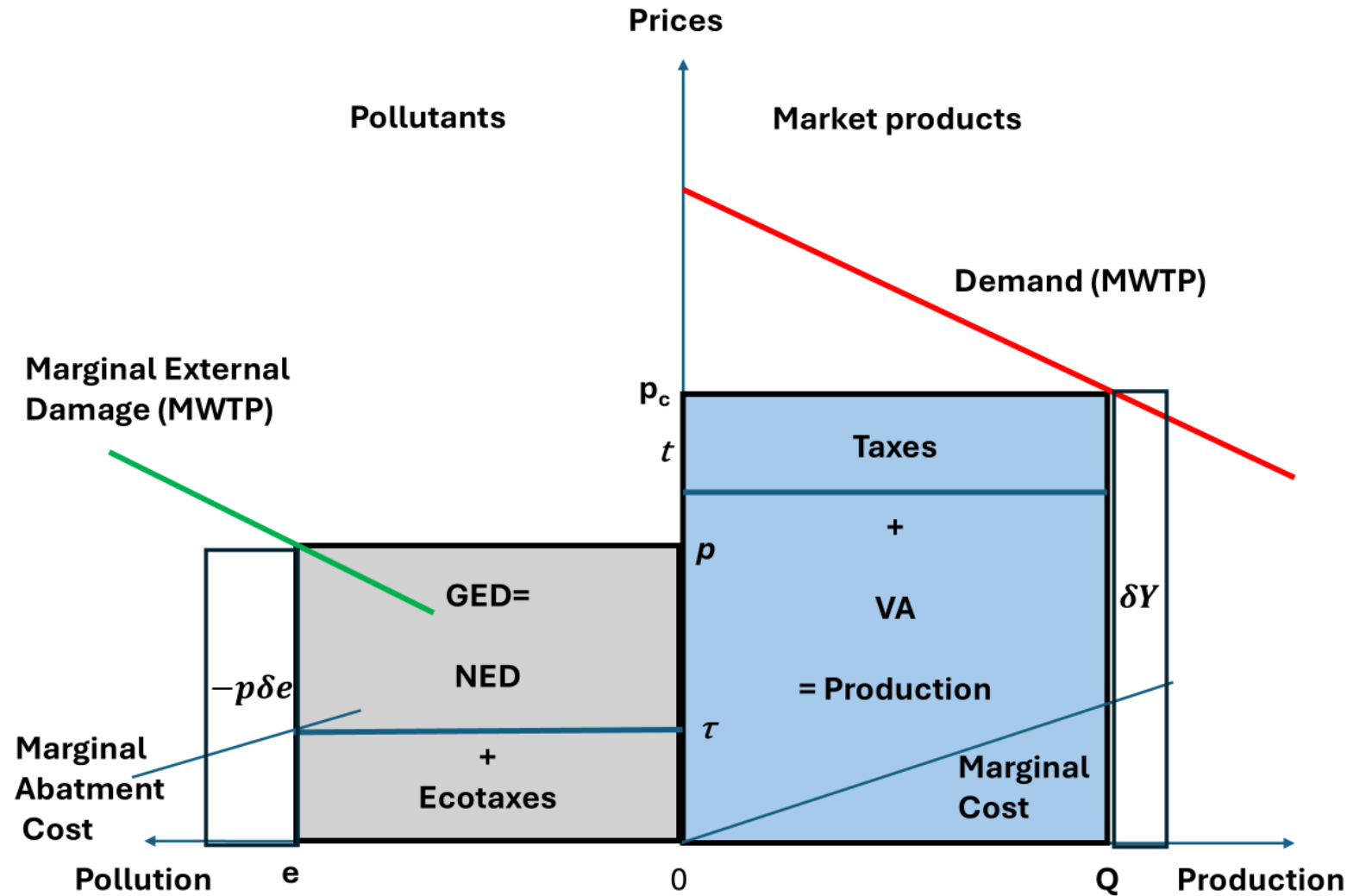
$$EB = -P^*.E + P.E^*$$

$$GS^R - S = -P.(E + E^*) = (GS^Y - S) - EB$$

2024	GHG (share %)	GDP (share %)	MCD (share %)	Emission Index E/Y	Damages Index P/SCC	GY-Y (% GDP)	-EB (% GDP)	GS ^R - S (% GDP)
Country	(1)	(2)	(3)	(4)=(1/2)	(5)=(3/2)	(6)	(7)	(8)
China	29.2	19.3	19.3	151	100	-10.0	+3.4	-6.6
USA	11.1	14.8	14.8	75	100	-5.0	-1.6	-6.6
UE-27	5.9	14.2	14.2	42	100	-2.8	-3.8	-6.6
India	8.2	8.2	8.2	100	100	-6.6	0	-6.6
Japan	2.0	3.2	3.2	63	100	-4.2	-2.4	-6.6
Brasil	2.4	2.4	2.4	100	100	-6.6	0	-6.6
ROW	41.2	37.9	37.9	109	100	-7.2	+0.6	-6.6
Total	100	100	100	100	100	-6.6	0	-6.6
	53.2	199,7	247		13,14			
	GtCO _{2eq.}	b\$ppa cur	c.\$/tCO ₂ (208\$2020)		b\$ cur.			

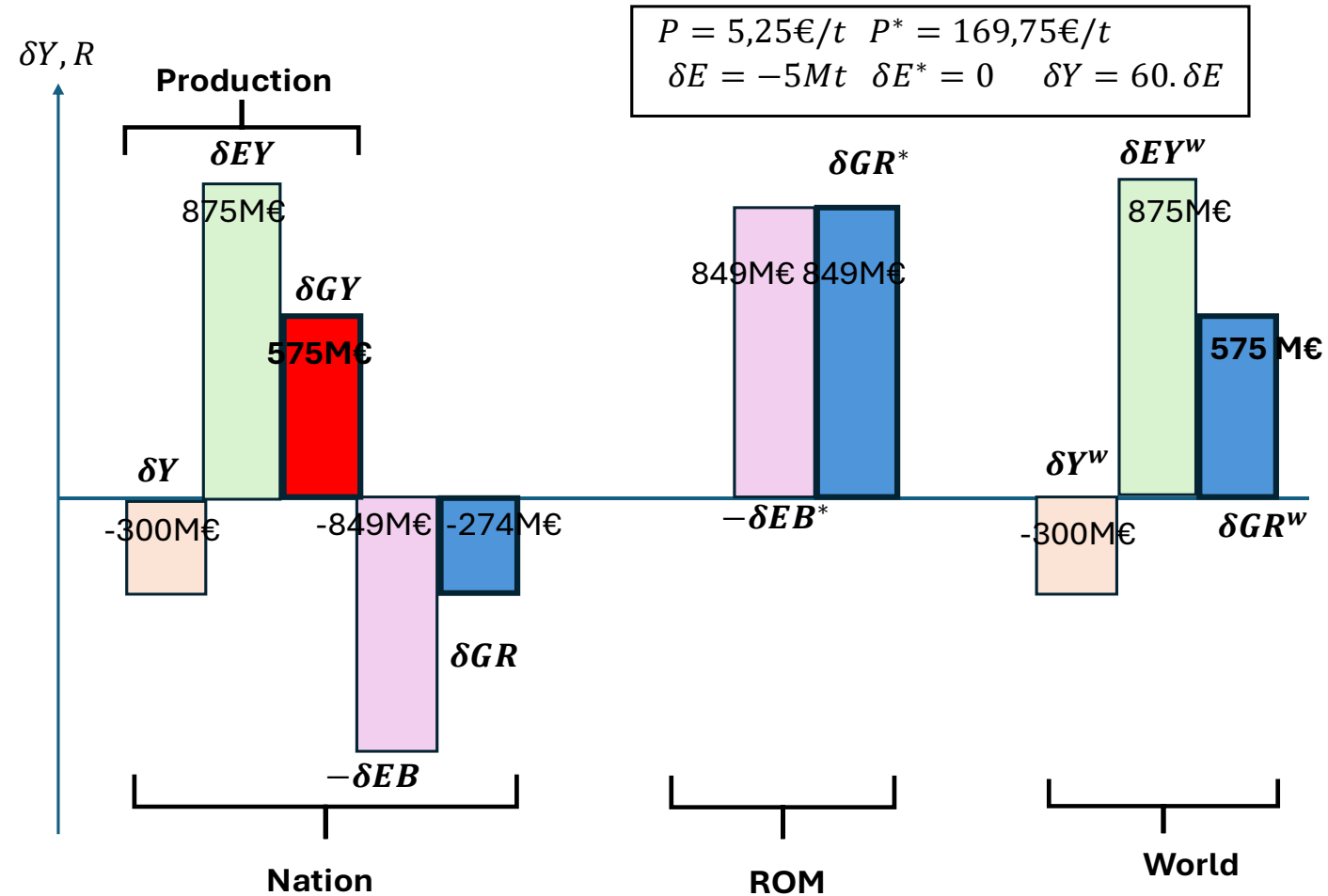
Highlighting public debates with expanded national accounts (1):

Expanded GDP variations at constant prices



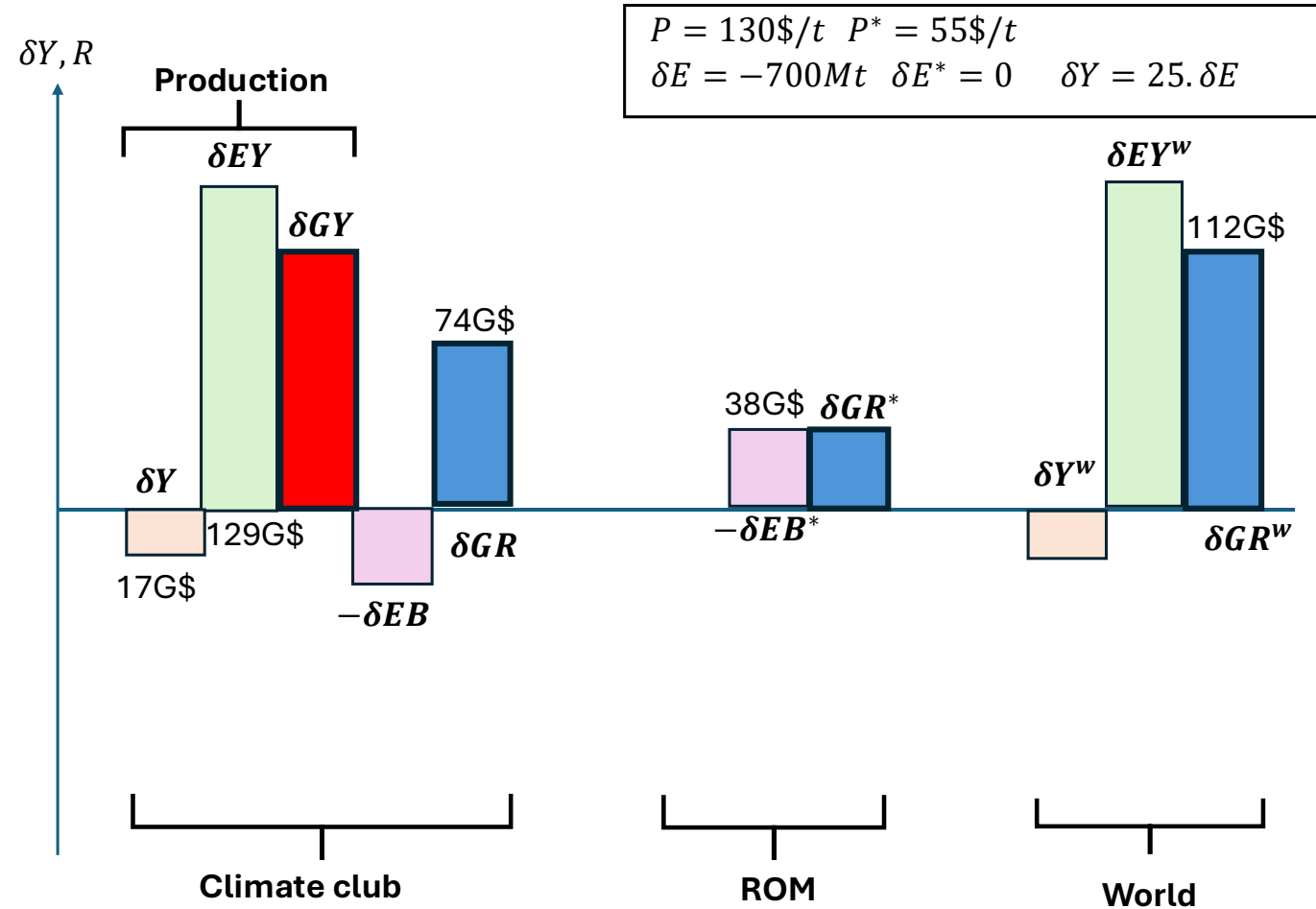
Highlighting public debates with expanded national accounts (2)

Illustration for a unilateral mitigation policy



Highlighting public debates with expanded national accounts (3)

Impact of sectoral agreements (Wolfram et al., Harvard-MIT GCPP, 2025)



Conclusion

- Prospects for implementation of these expanded national accounts depend on:
 - Availability of database on local and source emissions of pollution – complementarity with national environmental regulations (US/EU/FR)
 - Estimations of valuations of damages to the environment, especially country-level climate damages
 - Because of the remaining uncertainty around these estimations, need for appropriate and transparent governance to be put in place
 - Building a consensus within national accountants and within economists and between national accountants and economists on such a step (that does not exclude further developments).

See: [Laurence Bloch and Dominique Bureau \(2025\). Expanded National Accounts for the Environment. CREST WP 2025-17.](#)