Locally Incentive-Compatible Energy Prices and the Paris Agreement

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Efficient Energy Prices

Parry et al. (2014)

- Efficient prices fully reflect supply cost and external damages
- Pre-tax subsidy: price $<$ supply cost
- Post-tax subsidy: price $<$ supply cost $+$ external cost

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Coady et al. (2017)

- Global pre-tax subsidies estimated to be US$ 333 billion (0.4% of global GDP) in 2015
- Global post-tax subsidies estimated at US$ 5.3 trillion (6.5% of global GDP) in 2015

Energy Consumption Externalities

Global externality

- Climate change

Local externalities

- Local pollution (SO_2, NO_x, PM)
- Congestion
- Accidents
- Road damages

Literature Background

Major focus: Local co-benefits of mitigating GHG emissions

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- Marrouch and Chaudhuri (2016) for a summary on IEA literature

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$\rightarrow$ **Locally incentive-compatible energy prices**:

$$\text{price} = \text{supply cost} + \text{local externalities}$$

Research Question

Locally incentive-compatible energy pricing reform

- Local costs and benefits of implementing locally incentive-compatible energy prices through Pigouvian taxes and removal of pre-tax subsidies
- Global co-benefits in terms of CO_2 reduction

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Related studies

- Nam et al. (2013)
  - CGE analysis on China: SO_2 and NO_x targets in Twelfth Five Year Plan lead to CO_2 emission savings such that CO_2 intensity targets do not bind
- Parry et al. (2015)
  - PE analysis on top 20 emitters: Given local co-benefits, CO_2 prices of 57,5 $US on average are in countries own interest

Model and Data

Numerical Model

- Static multi-region, multi-sector CGE model of global trade and energy
- CES in production, consumption, and trade

Data

- GTAP 9 dataset version 9.2 and 9.2es (base-year 2011)
- Input-output, bilateral trade, and fuel-specific CO_2 data
- Coady et al. (2017), Parry et al. (2014)
  - Country-, fuel-, and use-specific marginal damage of fossil fuel consumption
  - Quantified damages from SO_2, NO_x, PM 2.5, congestion, accidents, road damage

Data Example

					Externalities					
Product	**Type of Use**	**Price Units**	**Supply Cost**	**Consumer Price**	**Global Warming**	**Local Pollution**	**Congestion**	**Accidents**	**Road Damage**	**Total**
Gasoline	Final	US$ per liter	0.95	1.19	0.09	0.04	0.03	0.76	-	0.93
	Intermediate		0.95	1.19	0.09	0.04	0.03	0.76	-	0.93
Diesel	Final	US$ per liter	0.98	0.86	0.11	0.10	0.02	0.30	0.01	0.55
	Intermediate		0.98	0.86	0.11	0.10	0.02	0.30	0.01	0.55
Kerosene	Final	US$ per liter	0.96	0.26	0.11	0.10	-	-	-	0.21
	Intermediate		0.96	0.26	0.11	0.10	-	-	-	0.21
Total Petroleum	All	US$ per liter	-	-	-	-	-	-	-	-
Coal	Final	US$ per GJ	4.41	4.41	3.72	6.50	-	-	-	10.22
	Intermediate		4.41	4.41	3.72	6.50	-	-	-	10.22
Natural Gas	Final	US$ per GJ	17.84	15.93	2.20	0.16	-	-	-	2.35
	Intermediate		17.84	15.93	2.20	0.16	-	-	-	2.35
Electricity	Final	US$ per kWh	0.10	0.09	-	-	-	-	-	-
	Intermediate		0.10	0.09	-	-	-	-	-	-

Source: Coady et al. (2017)

Model Sectors and Regions

Sectors and commodities	**Regions**
Energy sectors	MEN: Middle East and North Africa
Coal	SSA: Sub-Saharan Africa
Crude oil	CIS: Commonwealth of Independent States
Natural gas	EDA: Emerging and Developing Asia
Refined oil products	EME: Emerging Europe
Electricity	ADV: Advanced Economies
EITE sectors[*]	LAC: Latin America and the Caribbean
Non-ferrous metals	
Iron and steel	
Non-metallic minerals	
Chemicals and rubber	
Paper, pulp, and print	
Transport sectors	
Air transport	
Water transport	
Other transport	
Other sectors	
Agriculture	
All other goods	

[*] EITE – energy-intensive and trade-exposed sectors.

Scenarios

One scenario is composed of assumptions along four dimensions

Dimension	**Denotation**
Extent of Pigouvian taxation	none, LPOLL, NPOLL, FULL
Pre-tax subsidy removal	no, yes
Climate policy	none, Paris, Paris+, Paris-2C
International market response	SOE, MRT

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Focus here:

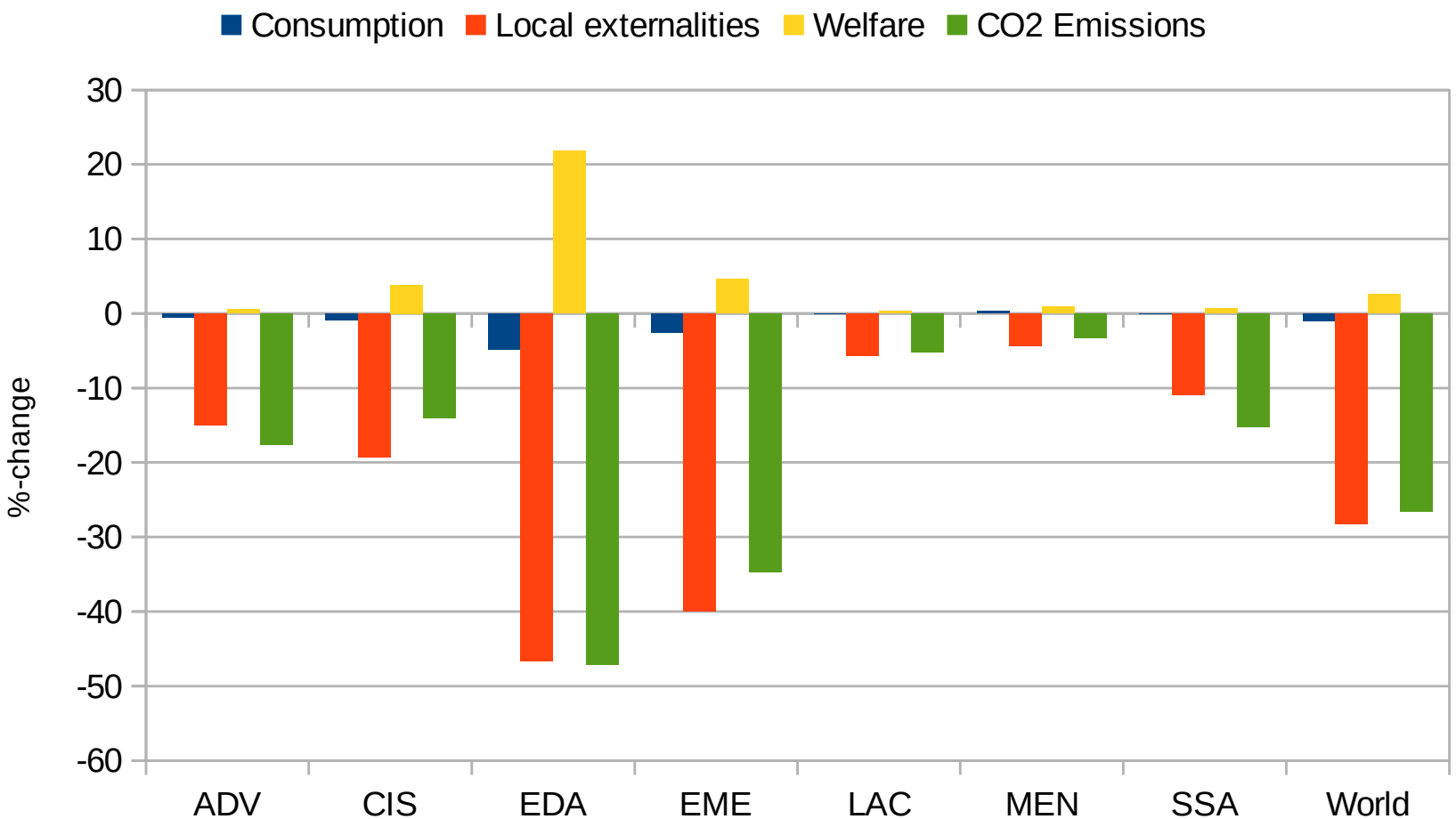
1. LPOLL under SOE and MRT
2. Paris combined with none, LPOLL, FULL under SOE and MRT

Business-as-Usual Overview

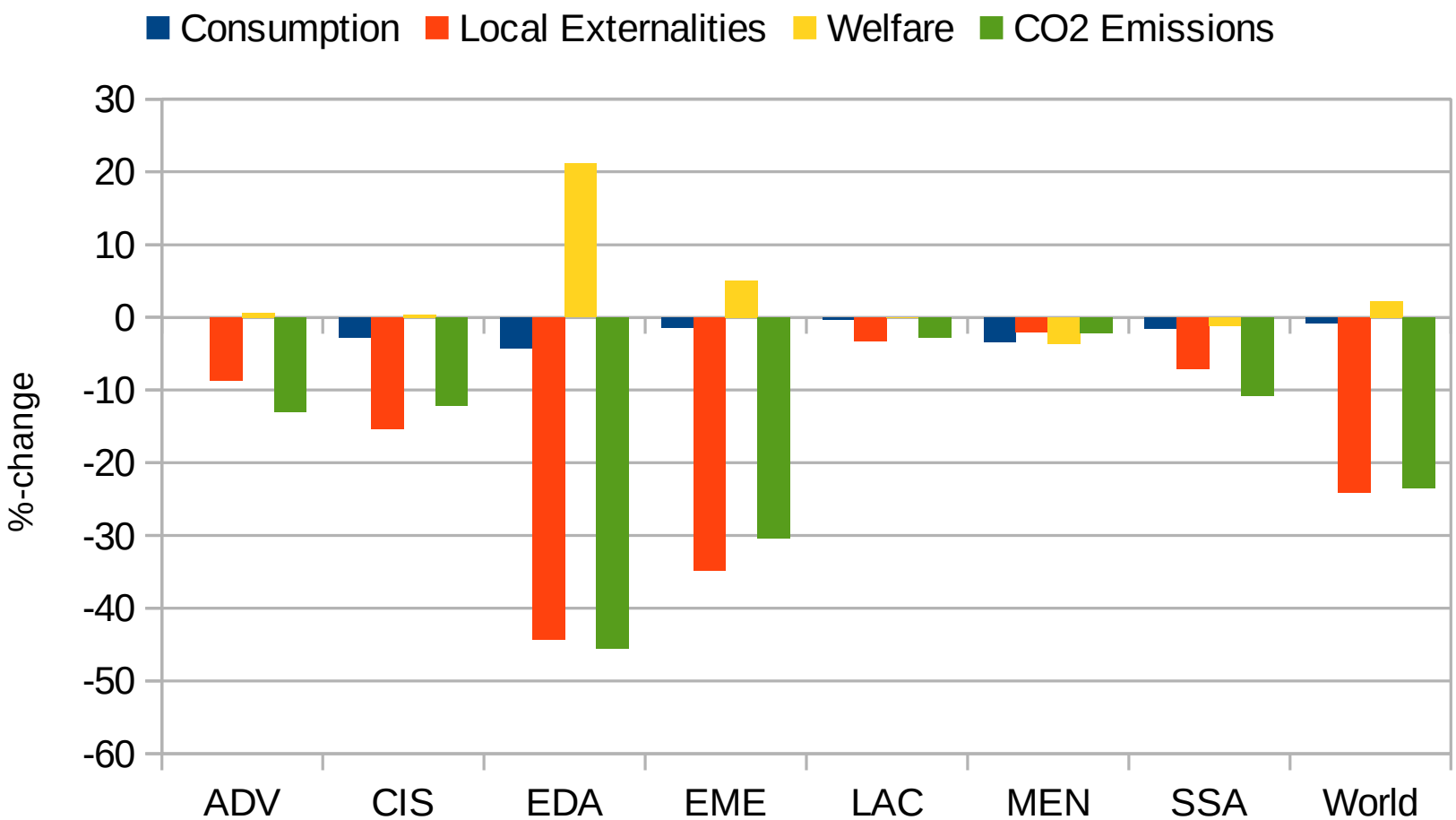
	Consumption[a]	Local Externalities[a]	Welfare[a]	CO_2 Emissions[b]	CO_2 Externality[a,c]
ADV	28064	2029	26035	11.4	
CIS	1275	259	1016	2.3	
EDA	5218	2030	3188	10.0	
EME	1265	205	1059	0.8	
LAC	3755	232	3523	1.5	
MEN	1626	188	1438	1.9	
SSA	893	56	837	0.6	
World	42096	5000	37096	28.4	1421

[a] In billion 2011 $US.
[b] In Gt.
[c] Assumed social cost of carbon of 50 $US.

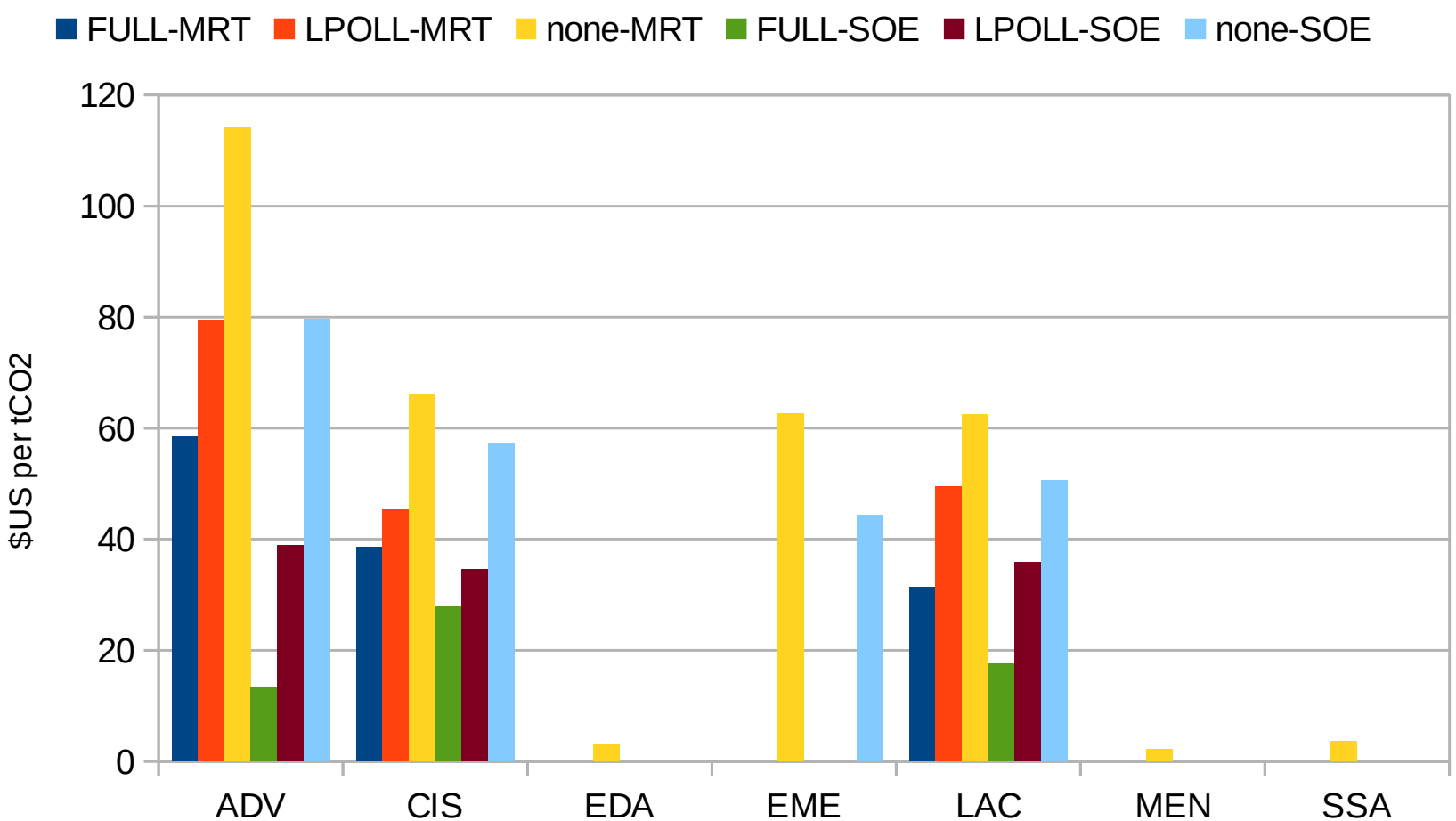
Scenario LPOLL-SOE



Scenario LPOLL-MRT



CO_2 prices to achieve Paris NDCs



Conclusion and Outlook

Conclusion

- Potential regional gains from pushing towards locally incentive-compatible energy prices are substantial
- Global co-benefits in terms of CO_2 emission reductions are substantial; Compliance cost for Paris NDCs decline markedly
- Highly integrated international markets make it necessary to include MRT for efficiency and incidence analyses
  - In the MRT setting, MEN, SSA, and LAC even lose in overall welfare in a global Pigouvian taxation scheme

Ongoing research

- Full regional disaggregation
- Sensitivity analyses on external cost parameters

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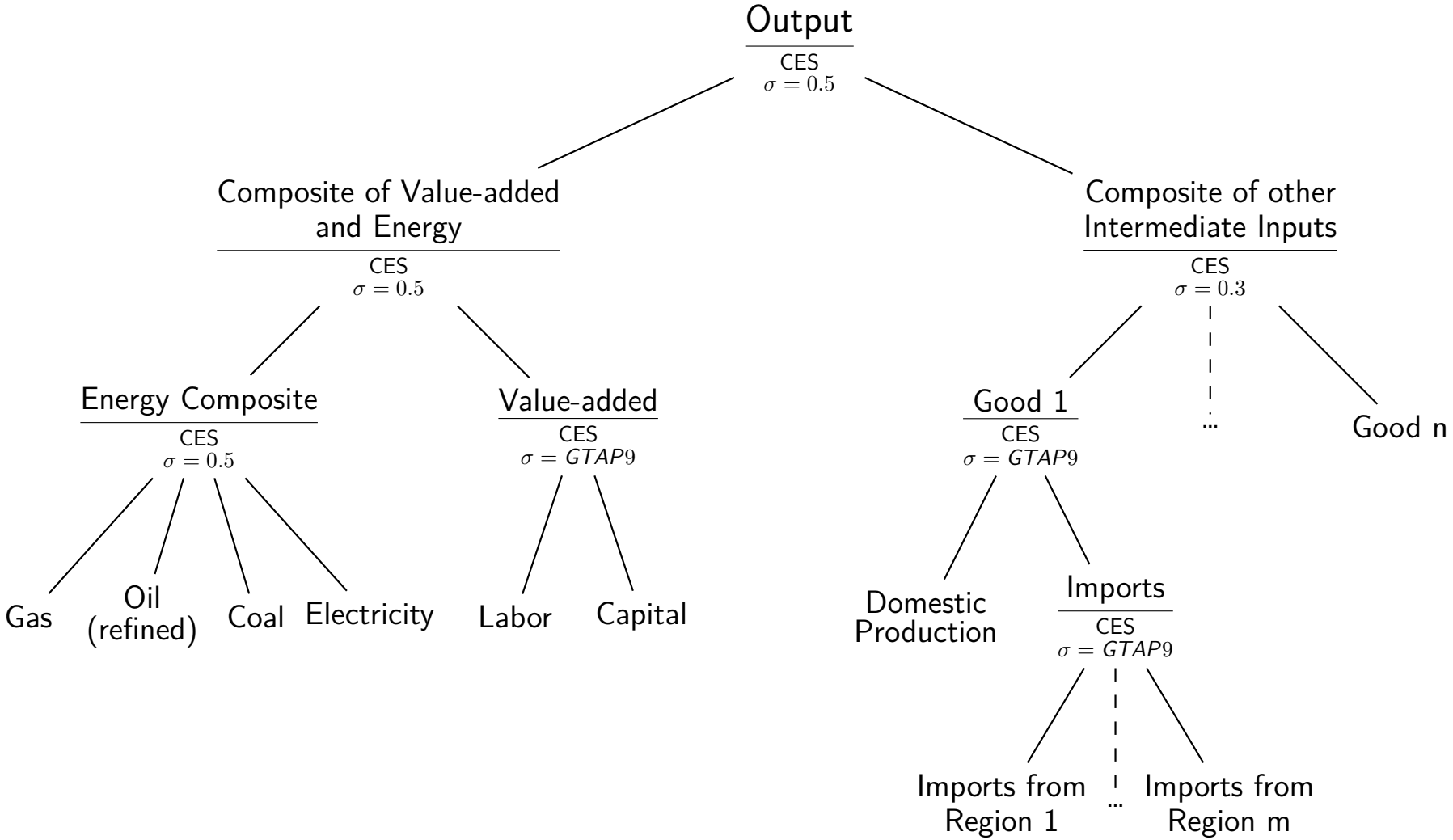
CGE Model – Production



$$\Pi_Y = P - \left[\theta_{KLE} p_{KLE}^{(1-\sigma_{KLEM})} + (1-\theta_{KLE}) p_M^{1-\sigma_{KLEM}}\right]^{\frac{1}{1-\sigma_{KLEM}}} \leq 0$$

θ_{KLE} – value share of energy and value-added; p_{KLE} – composite price of energy and value-added; σ_{KLEM} – top-level elasticity of substitution; p_M – composite price of other intermediate inputs