Assessing the impacts of international response measures in Ghana

Dorothee Flaig and Scott McDonald

dorothee.flaig@uni-hohenheim.de

International Agricultural Trade and Food Security

Hohenheim University, Germany

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Outline

- Planned simulations

- Method

    Database

    Computable General Equilibrium (CGE) model

    Strength and qualifications of the approach

Planned simulations

1. IMO carbon tax (maritime transport) – uniform carbon tax

    Worldwide uniform carbon tax on maritime transport

    Two alternatives: $50 and $100 per ton levy on greenhouse gas emissions

2. ICAO/CORSIA carbon tax (air transport)

    Worldwide uniform carbon tax on air transport

    Similar to IMO: Two alternatives: $50 and $100 per ton levy on greenhouse gas emissions

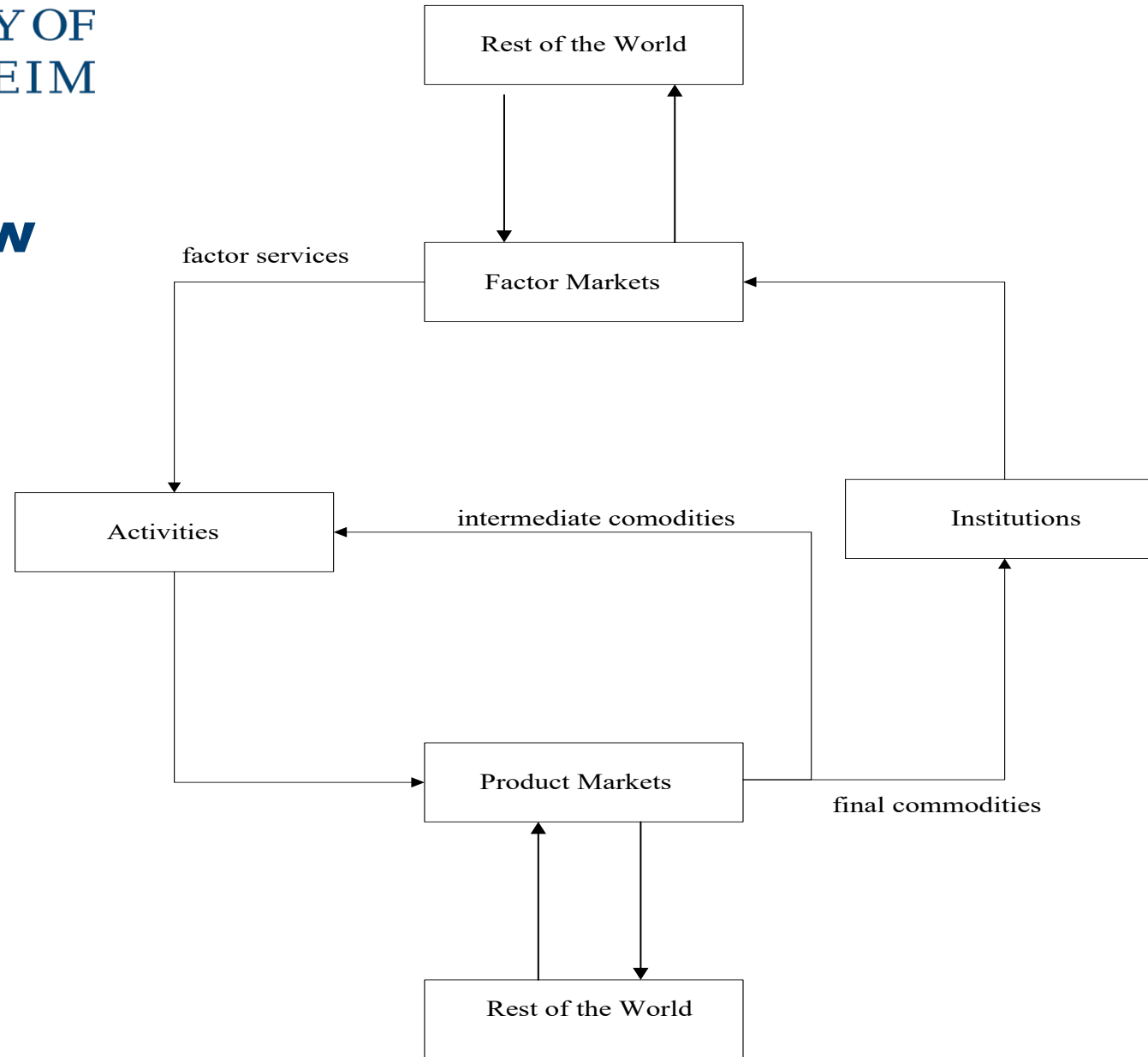   Including effects on tourism

3. EU CBAM tax:

    On imports, Worldwide, no exemption LDCs

    Sectors: Cement, Iron & Steel, Aluminum, Fertilizers

    Emissions: scope 1; Benchmark: national average by sector

Circular flow

A Social Accounting Matrix (SAM) for Ghana (Billion US$)

	COMM.	ACT.	VA.	HH.	TMTAX	TETAX	TSDTAX	GOVTN	KAPITAL	MARGS	WORLD	TOTALS
COMMDTY (37)		32.9		25.9				7	10.1		12.2	88.1
ACTIVITY (37)	67.2											67.2
VALUAD (5)		33.1										33.1
HHOLDS			28.5					2.3				30.8
TMTAX (12)	1.4											1.4
TETAX (12)	0											0
TSDTAX		0		0								0.1
GOVTN	3.2	1.1	-0.2	1.8	1.4	0	0.1					7.5
KAPITAL			4.8	3				-1.8			4	10.1
MARGS (3*12)	0.5											0.5
WORLD (12)	15.8									0.5		16.2
TOTALS	88.1	67.2	33.1	30.8	1.4	0	0.1	7.5	10.1	0.5	16.2	

Rest of Africa

	COMMDTY	ACTIVITY	VALUAD	HHOLDS	TMTAX	TETAX	TFTAX	TSDDTAX	GOVTN	KAPITAL	MARGS	WORLD	TOTALS
COMMDTY		1472		1220					278	391		434 (Ghana 1, EU 143)	3795
ACTIVITY	3220												3220
VALUAD		1654											1654
HHOLDS													
TMTAX	26												
TETAX	3												
TFTAX		53											
TSDDTAX		5											
GOVTN	49	36											
KAPITAL													
MARGS	16												
WORLD	481 (Ghana 1, EU 132)												
TOTALS	3795	3220											

EU

	COMMDTY	ACTIVITY	VALUAD	HHOLDS	TMTAX	TETAX	TFTAX	TSDDTAX	GOVTN	KAPITAL	MARGS	WORLD	TOTALS
COMMDTY		16193		8554					3368	3221		6351 (Ghana 3, rAfr 132)	37686
ACTIVITY	30204												30204
VALUAD		10886											10886
HHOLDS													
TMTAX	31												
TETAX	2												
TSDDTAX		314											
GOVTN	1293	263											
KAPITAL													
MARGS	135												
WORLD	6022 (Ghana 3, rAfr 143)												
TOTALS	37686	30204											

Ghana

	COMM	ACTIVITY	VALUAD	HHOLDS	TMTAX	TETAX	TSDDTAX	GOVTN	KAP.	MARG	WORLD	TOTAL
COMMDTY		32.9		25.9						7	12.2 (rAfr 1, EU 3)	88.1
ACTIVITY	67.2											67.2
VALUAD		33.1										33.1
HHOLDS				28.5					2.3			30.8
TMTAX	1.4											1.4
TETAX	0											0
TSDDTAX		0		0								0.1
GOVTN	3.2	1.1	0.2	1.8	1.4	0	0.1					7.5
KAPITAL			4.8	3						-1.8		10.1
MARGS	0.											0.5
WORLD	15.8 (rAfr 1, EU 3)										0.5	16.2
TOTALS	88.1	67.2	33.1	30.8	1.4	0	0.1	7.5	10.1	0.5	16.2	

A global database

Database used in project

- Based on GTAP database v10 (Aguiar et al. 2019):

  year 2014,

  identifies141 regions, 65 sectors

- Aggregated for the purpose of this study:

  Ghana and 12 aggregate regions

  37 sectors

  5 factors of production: unskilled labour, skilled labour, capital, land, natural resources

- Energy data (satellite account to SAM):

  quantities of energy commodities used (MTOE) and CO_2 emissions associated with each energy commodity and using agent

  sourced from GTAP (compiled by the International Energy Agency)

Aguiar, A., Chepeliev, M., Corong, E., McDougall, R., & van der Mensbrugghe, D. (2019). The GTAP Data Base: Version 10. Journal of Global Economic Analysis, 4(1), 1-27.

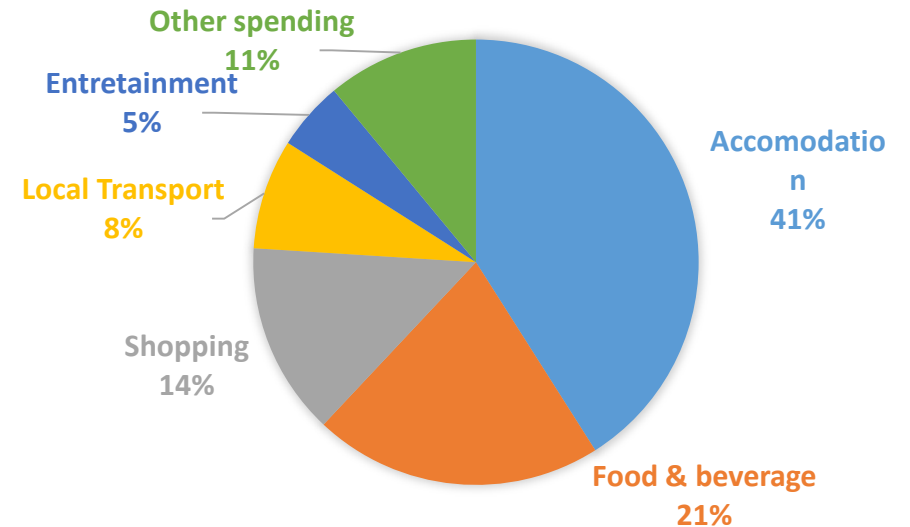| Regions	Sectors		
Ghana	Oil seeds	Textiles	Electricity
Africa LDCs	Crop agriculture	Petroleum, coal products	Gas manufacture and distr.
Rest of Africa	Fishing	Chemical products	Water supply and distr.
EU	Livestock agriculture	Basic pharmaceutical products	Construction
Rest of Europe	Coal	Rubber and plastic products	Land and pipeline transport
North America	Extraction of crude oil	Mineral products	Water transport
Central and South America, Caribbean	Extraction of natural gas	Ferrous metals	Air transport
Oceania	Other mining extraction	Aluminium and other metals	Trade services
East Asia	Vegetable oil and fats	Metal products	Tourism	Accommodation, Food and service activities
LDCs Asia and Oceania	Animal products	Electronics and equipment	Financial, communication and business services
Rest of Asia	Other food products	Machinery and equipment	Education and health services
Eastern Europe and Former Soviet		Motor and transport vehicles and parts	Recreational and other services
Western Asia		Other manufacturing	Public admin. and defence

Tourism data

- The model returns the increase in prices for air transport from a CORSIA carbon tax.

- To include tourism to add additional sets of information are needed:

1. The responsiveness of tourism arrivals to changes in air transport prices (price elasticity of demand for air travel; based on Scheelhase and Grimme, 2007)

   Business travellers: between -0.5 and -0.9
   Leisure travellers: between -1.1 and -1.5

2. Data on tourism sector in Ghana:(58% business, 42% leisure)

Year	Arrivals	Receipt (US$M)
2016	932,579	1651.67
2017	969,156	1804.56
2018	956,375	2,589.85
2019	1,130,307	3,312.93
Source: Ghana Immigration Service and Ghana Tourism Authority and 2019 Tourism Report		

Other spending 11%
Entretainment 5%
Local Transport 8%
Accomodation 41%
Shopping 14%
Food & beverage 21%

ANNARES model features

- Global Computable General Equilibrium (CGE) model, deriving from GLOBE developed by Scott McDonald and Karen Thierfelder (www.cgemod.org.uk)

  based on economic theory

  simultaneous determination of prices and quantities in multiple inter-connected markets.

- series of single country CGE models, linked through their trading relationships

- Static version

- Nested production structure (mix of imperfect substitution and fixed shares, flexible nesting structure)

- Imports and domestic products are imperfect substitutes (also exports and domestic supply; by partner)

- Various taxes, including taxes on energy inputs and carbon emissions
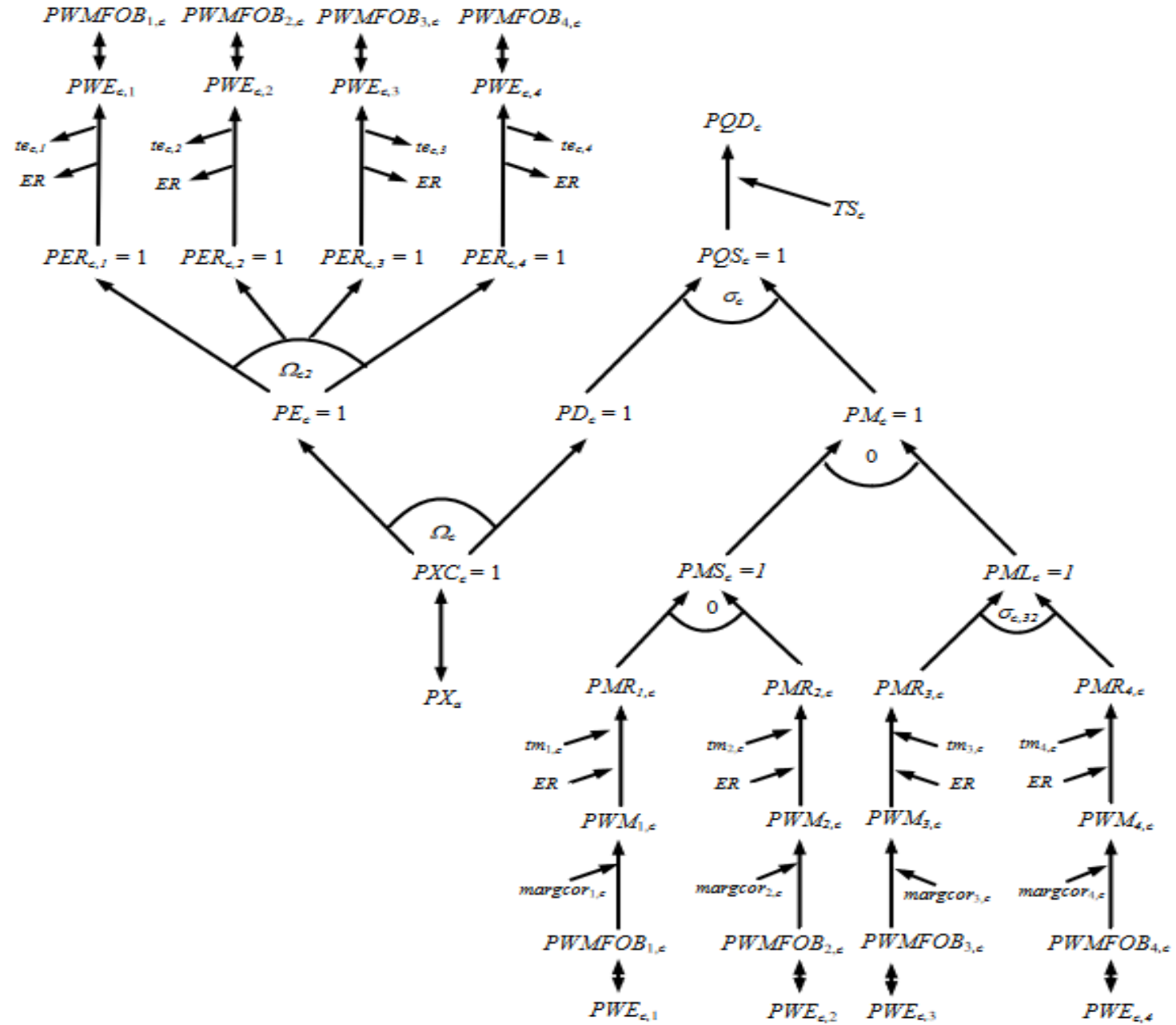
Applications

- Global: effects of reducing global carbon emissions by 20%, various alternative policies

- The impact of rm on low-income countries differs by policy instrument, even when low-income countries are exempt from the policies imposed:

  o The most efficient instrument is a tax on carbon with the smallest impact on world prices and the exchange rates of low-income regions.

  o Country differences arising from differing trade structures: E.g., mitigation strategies in the rest of the world decreases the import price of electricity in West Africa but increases the price of electricity in East Africa
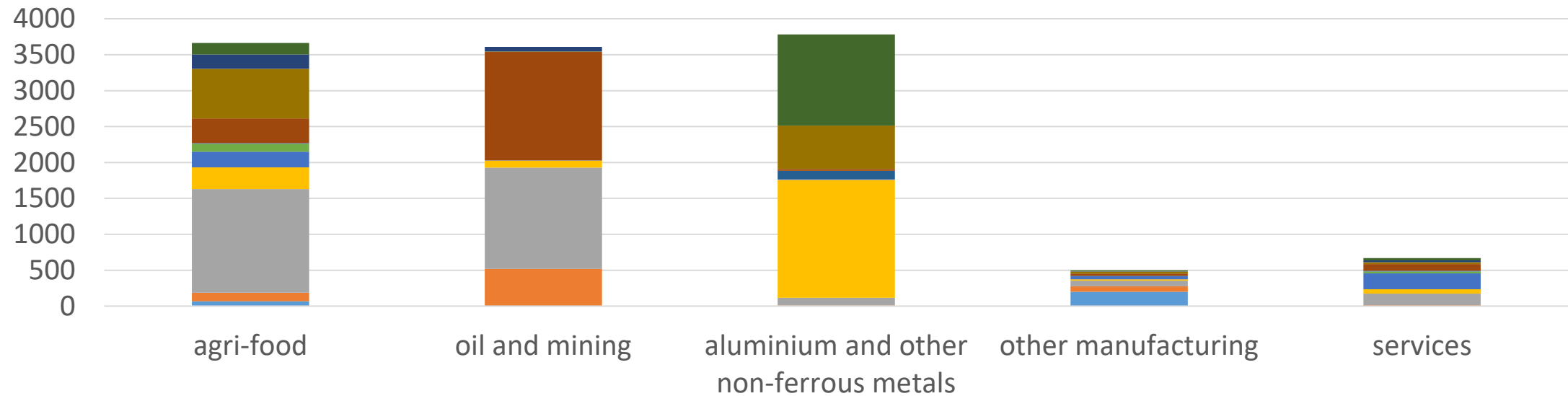
Assessing impacts of the implementation of response measures

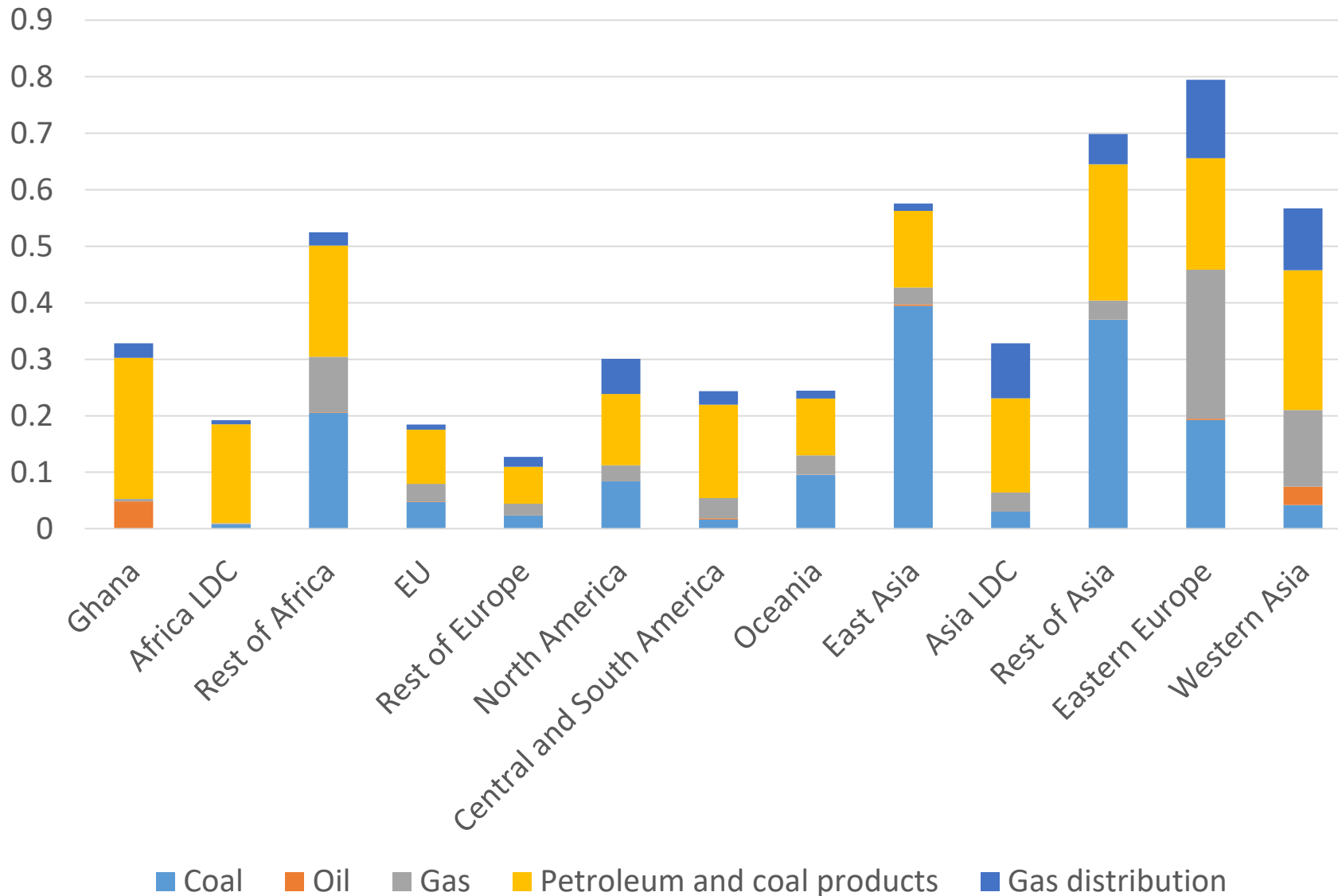The case study of Senegal and Kenya: A Computable General Equilibrium Analysis

8 DECENT WORK AND ECONOMIC GROWTH

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

10 REDUCED INEQUALITIES

GLOBE Model

STAGE Model

Ghana exports by partner (Mio. US$)

CO2 emissions (kg per GDP)

Legend: Coal, Oil, Gas, Petroleum and coal products, Gas distribution

CO2 emissions (metric tons per capita)	
Ghana	0.5
Africa LDC	0.2
Rest of Africa	1.8
EU	6.5
Rest of Europe	6.9
North America	12.8
Central, South America	2.5
Oceania	14.5
East Asia	6.2
Asia LDC	0.4
Rest of Asia	1.6
Eastern Europe	7.6
Western Asia	6.3

Advantages of CGE

- Theoretical consistent

- Highlight the importance of linkages between sectors

- Incorporate unique features of an economic system.

- CGE therefore suited to analyse

  o effects of policies, i.e., policies that affect multiple sectors or regions and/or result in changes of behaviour

  o "what if"-type of scenarios (ex-ante)

  o used widely in international trade, public finance, regional economics, and environmental economics.

Qualifications

- The data requirements of CGE models are substantial (Database and parameters)

- The global SAM database will deviate from National Account data published by statistical offices. Reasons are, e.g.:

    - SAM needs to be complete and consistent – transactions must be reconciled
    - E.g., Imports of region A from B need to be equal to exports of region B to A

- Limited sector detail: By covering all sectors in an economy, a CGE model may miss key features of critical sectors.

- Complexity:

    human capital investment required to build, use and analyse these models

    the 'blackbox' critique (ANNARES is well documented)

Thank you!