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Modeling Sustainable Development for Europe in a Global Framework

by

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1. MOSUS project

MOSUS (Modelling Opportunities And Limits For Restructuring Europe Towards Sustainability)

⇒ <http://www.mosus.net>

MOSUS is funded by the 5th framework programme of the European Union

MOSUS is endorsed by the Industrial Transformation Project of the International Human Dimensions Programme (IHDP-IT)

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2 partners

International Institute
for Applied Systems
Analysis, Austria



National Institute for
Engineering and Industrial
Technology, Portugal



Sustainable Europe
Research Institute,
Austria



Research Centre on the
Portuguese Economy,
Portugal



Charles University
Prague, Environmental
Center, Czech Republic



Research Centre for
Sociological Studies,
Portugal



London School of
Economics, UK



University of Lodz,
Poland



Austrian Institute of
Economic Research,
Austria



Center for International
Climate and Environmental
Research, University of Oslo



Institute for Sustainable
Development, Poland



Gesellschaft für wirtschaftliche
Strukturforschung mbH, Germany



≈ **targets**

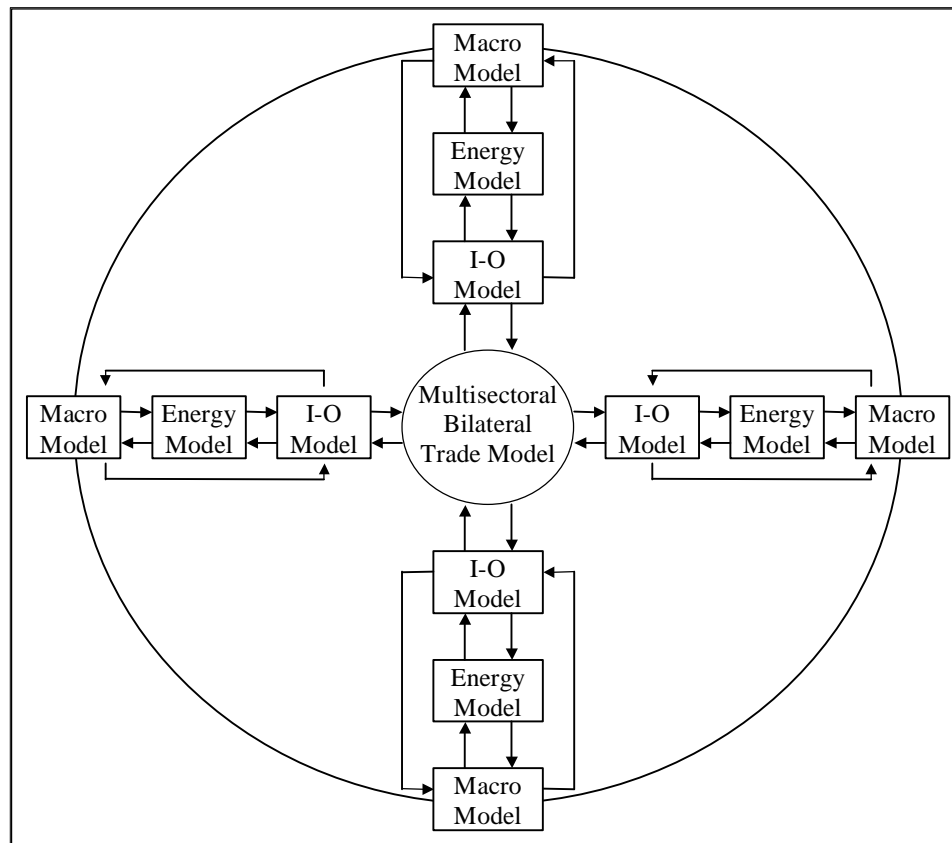
- analysis of the interrelations of three major policy themes:
 - § sustainable development
 - § competitiveness and social cohesion
 - § globalization and international trade
- application of a simulation model to develop:
 - § policy strategies for a sustainable development in Europe considering the interrelations of:
 - resource and land use, energy consumption,
 - economic development
 - and fundamental social indicators

≈ **consequences for modeling**

- ⊖ endogenous explanation of economic development and its linkage with the environment
- ⊖ global multisector/multicountry approach
- ⊖ disaggregated international trade
- ⊖ agents behave under conditions of bounded rationality: econometrically estimated parameters

â **requirements are fulfilled
by the model COMPASS/GLODYM**

2 structure of COMPASS / GLODYM



geographical coverage:

Model type	countries & regions
trade model:	53
macro-models:	31
macro-simulators:	22
IO-models:	20
energy-models:	17

data base:

macro:	UN, IFS
input-output:	OECD, APERC
energy:	IEA

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- o Documentation in:
 - § Uno, K. (ed.): Economy – Energy – Environment Simulation. Beyond the Kyoto Protocol. Kluwer 2002.
- o International research team:
 - § Keio University, Japan
 - § Economic Information Centre, China
 - § ERI, Belgium
 - § GWS, Germany
- o Financial support from Japanese government
- o Technically improved version „GLODYM“

≈ **planned further work**

- ⊖ extension of the model:
 - § EU coverage inclusive accession countries
 - § material input models
 - § land use models
 - § endogenization of consumption structures
- ⊖ up-dating of the whole system (last year covered 2001)
- ⊖ scenario formulation for exogenous variables

≈ **reasons for the construction of a new model**

- ō world wide change in the statistics to SNA 93
- ō progress in the software development of GWS
- ō change to OECD – SNA,
 - STAN,
 - trade data

⇒ **new model GINFORS based on the experiences made with COMPASS**

Global Interindustry FORecasting System

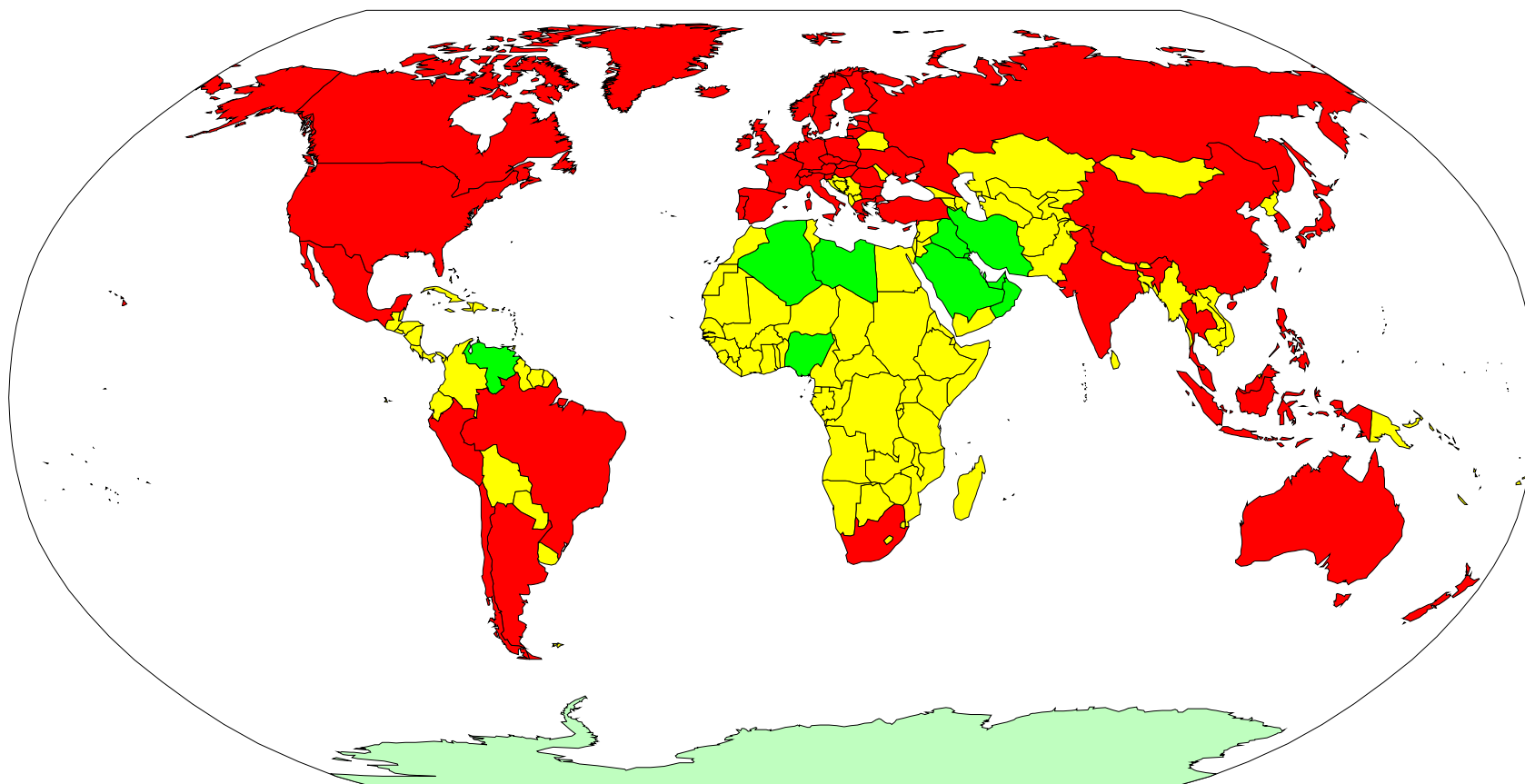
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2. GINFORS

² data sources and coverage

model type		data sources	geographical coverage
trade		OECD	40 countries, 2 regions (OPEC, ROW), 25 sectors + services
country models	input-output	OECD, EUROSTAT, APEREC	20 – 30 countries
	macro	OECD / IMF	53 countries
	energy	IEA	53 countries
	material	SERI	30 – 40 countries
	land-use	IIASA	20 – 30 countries

2 country coverage

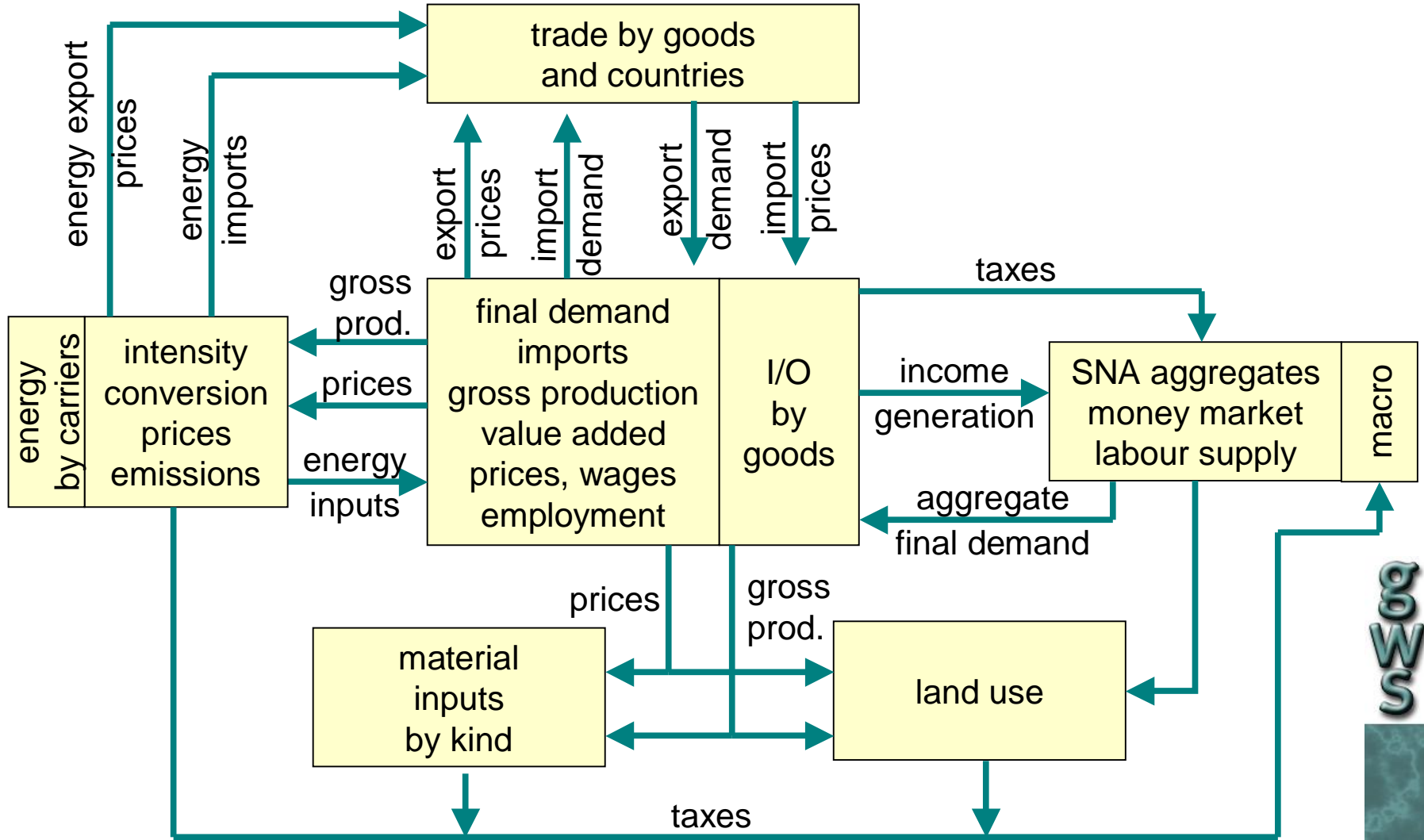


country models

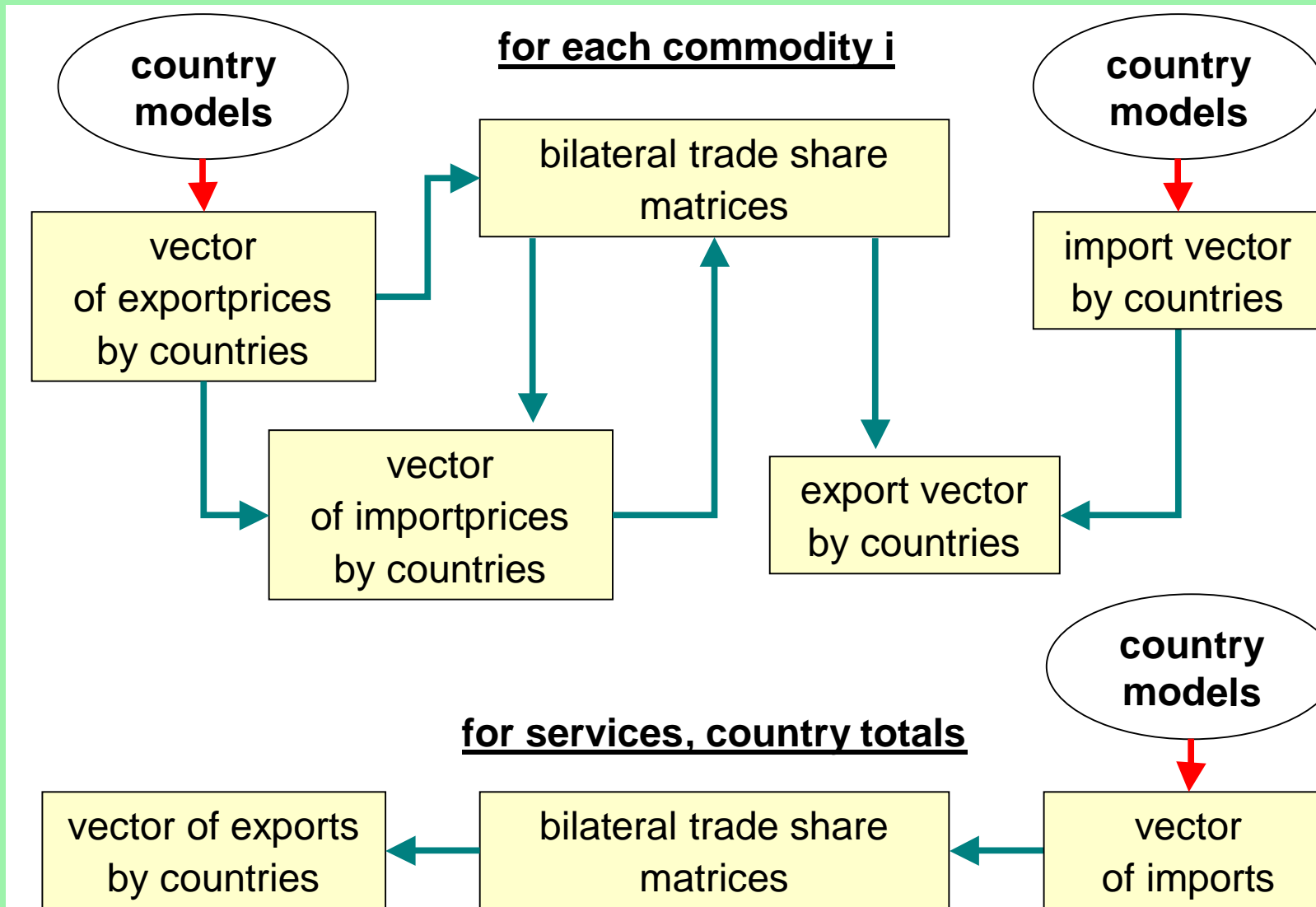
OPEC ex. Indonesia

ROW

≈ model structure for a specific country



2.1 Trade model



Trade-matrix T of good i:
 exports from country l to country
 k in thousand US\$

		Importing Countries k							Σ								
		1	2	3	4	5	...	42									
Exporting Countries l	T	T_{lk}							X_l								
	1																
	2																
	3																
	4																
	5																
	..																
	42																
	Σ									m_k							i

countries
 $l, k = \{1, \dots, 42\}$

goods
 $i = \{1, \dots, 25\}$

x_l ~ total exports of country l
 of good i

m_k ~ total imports of country k
 of good i

trade shares
 $S_{lk}^i = T_{lk}^i / m_k^i$



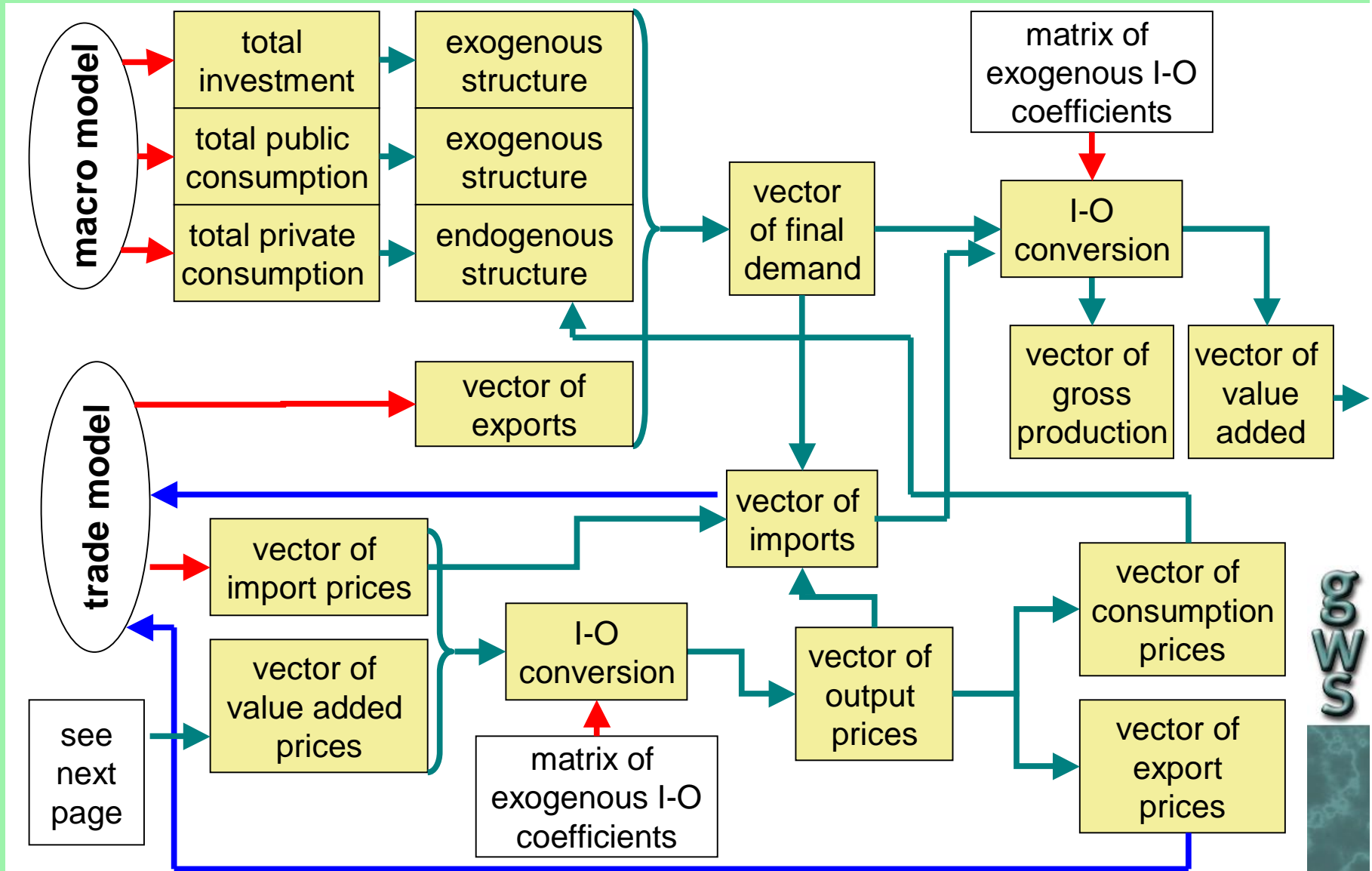
goods of OECD Trade

AGRICULTURE, HUNTING, FORESTRY AND FISHING
MINING AND QUARRYING
FOOD PRODUCTS, BEVERAGES AND TOBACCO
TEXTILES, TEXTILE PRODUCTS, LEATHER AND FOOTWEAR
WOOD AND PRODUCTS OF WOOD AND CORK
PULP, PAPER, PAPER PRODUCTS, PRINTING AND PUBLISHING
COKE, REFINED PETROLEUM PRODUCTS AND NUCLEAR FUEL
CHEMICALS EXCLUDING PHARMACEUTICALS
PHARMACEUTICALS
RUBBER AND PLASTICS PRODUCTS
OTHER NON-METALLIC MINERAL PRODUCTS
IRON AND STEEL
NON-FERROUS METALS
FABRICATED METAL PRODUCTS, except machinery and equipment
MACHINERY AND EQUIPMENT, N.E.C.
OFFICE, ACCOUNTING AND COMPUTING MACHINERY
ELECTRICAL MACHINERY AND APPARATUS, NEC
RADIO, TELEVISION AND COMMUNICATION EQUIPMENT
MEDICAL, PRECISION AND OPTICAL INSTRUMENTS
MOTOR VEHICLES, TRAILERS AND SEMI-TRAILERS
BUILDING AND REPAIRING OF SHIPS AND BOATS
AIRCRAFT AND SPACECRAFT
RAILROAD EQUIPMENT AND TRANSPORT EQUIPMENT N.E.C.
MANUFACTURING NEC; RECYCLING
ELECTRICITY, GAS AND WATER SUPPLY

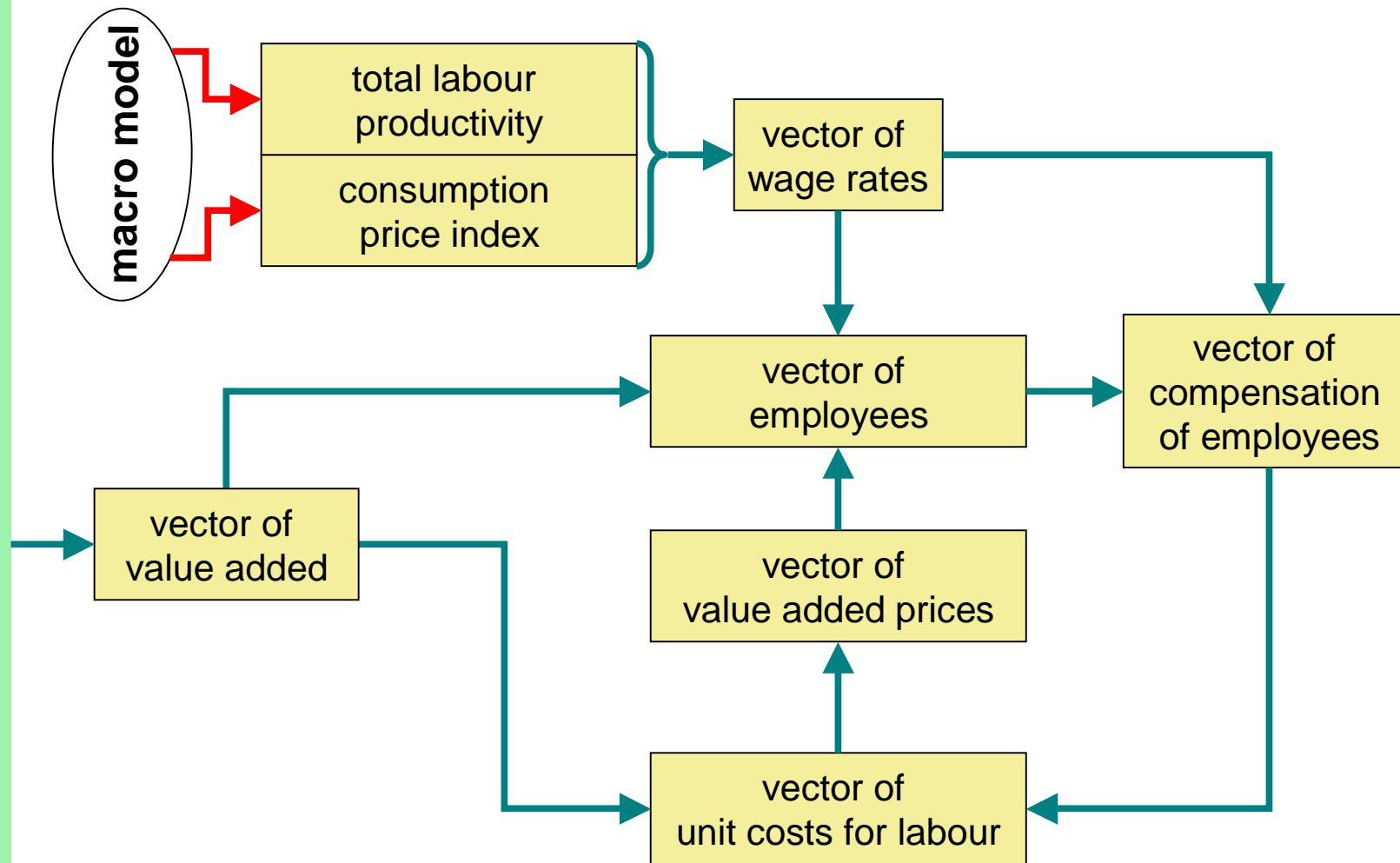
country coverage of
OECD Trade

OECD		Non OECD
Austria	Czech Republic	China
Belgium	Hungary	Hong Kong
Luxembourg	Poland	Indonesia
Denmark	Slovak Republic	India
Finland	Turkey	Malaysia
France	Iceland	Philippines
Germany	Norway	Singapore
Greece	Switzerland	Thailand
Ireland	Canada	Taiwan
Italy	Mexico	Argentina
Netherlands	United States	Brasil
Portugal	Japan	OPEC
Spain	Korea	ROW
Sweden	Australia	
United Kingdom	New Zealand	

2.2 Input-output-models

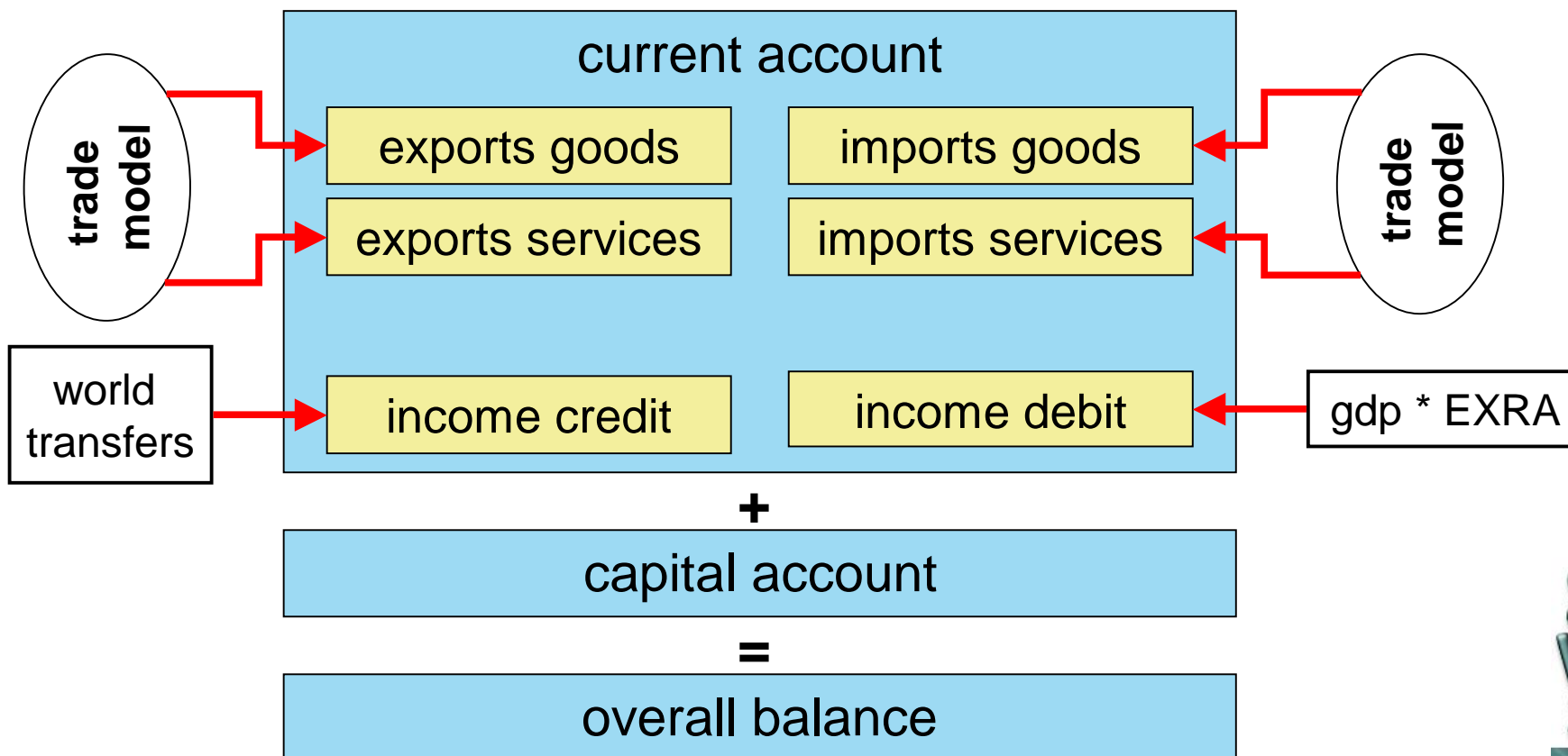


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2.3 Macro-models

≈ Balance of payments in US \$



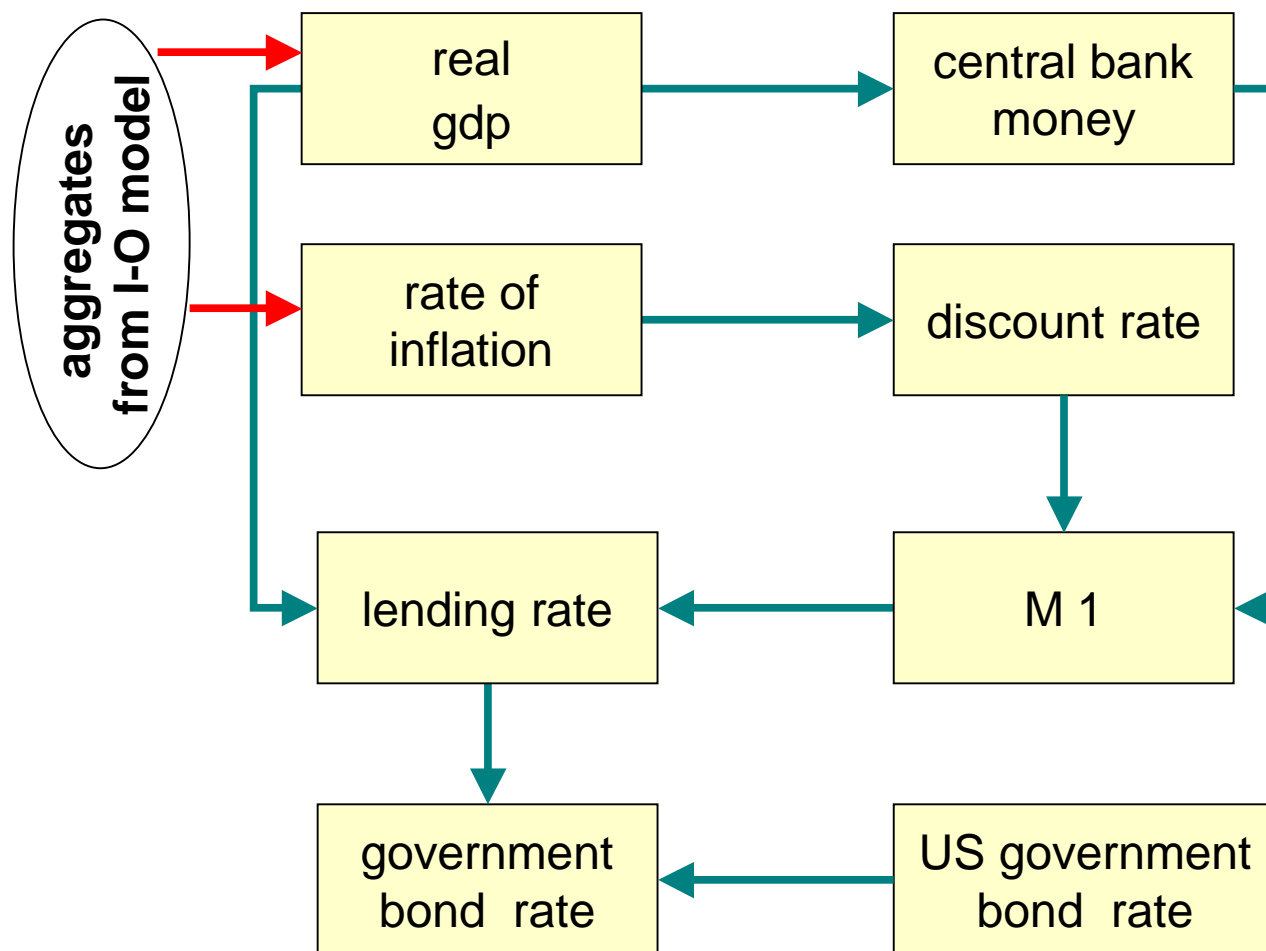
≈ **Estimation of the exchange rate as a reduced form of the balance of payments**

$$\text{EXRA} = \text{EXRA} (r, r^{\text{US}}, p, p^{\text{US}}, \text{gdp}, \text{gdp}^{\text{US}}, \text{EXRA}_{t-1})$$

r ~ discount rate

p ~ GDP-price

2 Money market



2 SNA-Aggregates

	Total compensation of employees
+	Total gross operating surplus and gross mixed income
+	Total other taxes less other subsidies on production
=	Total gross value added
./.	FISIM (Financial Intermediation Services Indirectly Measured)
=	Gross value added at basic prices, excluding FISIM
+	Taxes less subsidies on products
+	Statistical discrepancy (output approach)
=	Gross domestic product (expenditure approach)
+	Net primary incomes from the rest of the world
=	Gross national income at market prices
./.	Consumption of fixed capital
=	Net national income at market prices or Balance of primary incomes, net
+	Net current transfers from the rest of the world
=	Net national disposable income, or Disposable Income, net
+	Adjustment for the change in net equity of households in pension reserves funds
./.	Final Consumption Expenditures
=	Saving, net
+	Net capital transfers from the rest of the world
./.	Gross capital formation
+	Consumption of fixed capital
=	Net lending/net borrowing

2 Budget of the government

	Net national income at market prices or Balance of primary incomes, net
+	Current taxes on income, wealth etc., receivable
+	Social contributions, receivable
+	Other current transfers, receivable
./.	Social benefits other than social transfers in kind, payable
./.	Other current transfers, payable
=	Net national disposable income, or Disposable Income, net
./.	Final Consumption Expenditures
=	Saving, net
+	Capital transfers, receivable
./.	Capital transfers, payable
./.	Gross capital formation
./.	Acquisitions less disposals of non-produced non-financial assets
+	Consumption of fixed capital
=	Net lending/net borrowing

2 Budget of the private sector

Net national income at market prices or Balance of primary incomes, net

Net national disposable income, or Disposable Income, net

./. Final Consumption Expenditures

= Saving, net

+ Net capital transfers from the rest of the world

+ Capital transfers, receivable

./. Capital transfers, payable

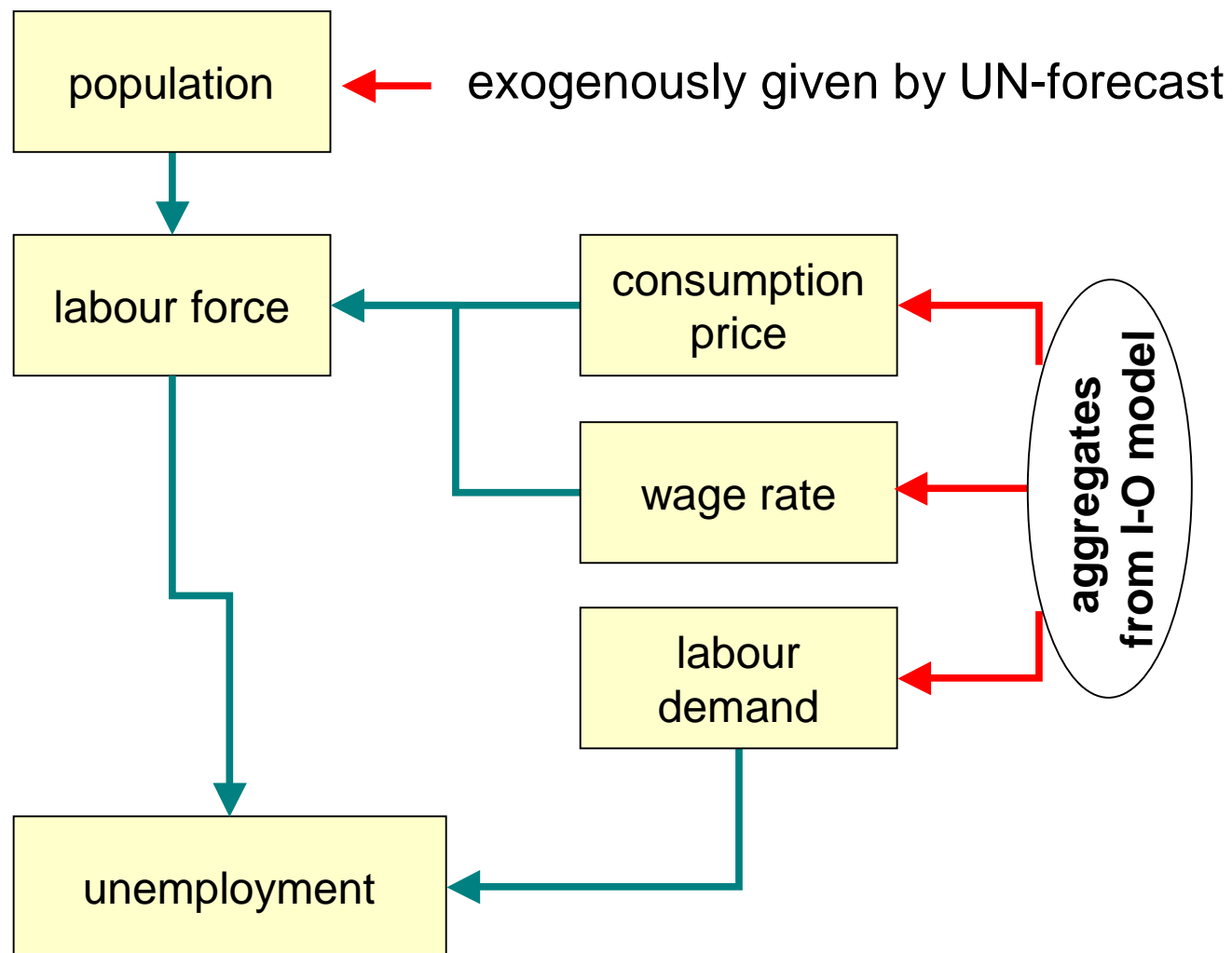
./. Gross capital formation

./. Acquisitions less disposals of non-produced non-financial assets

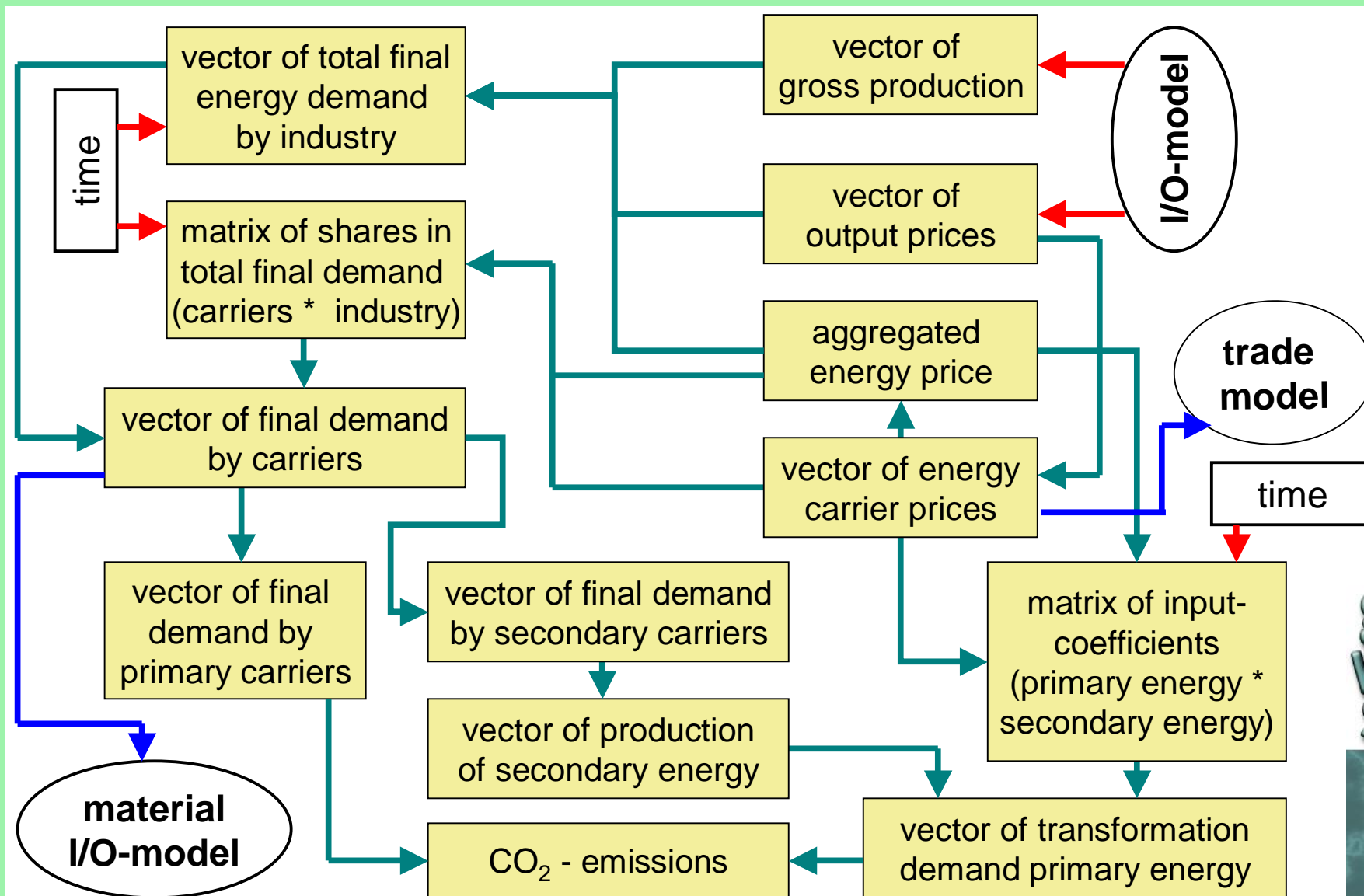
+ Consumption of fixed capital

= Net lending/net borrowing

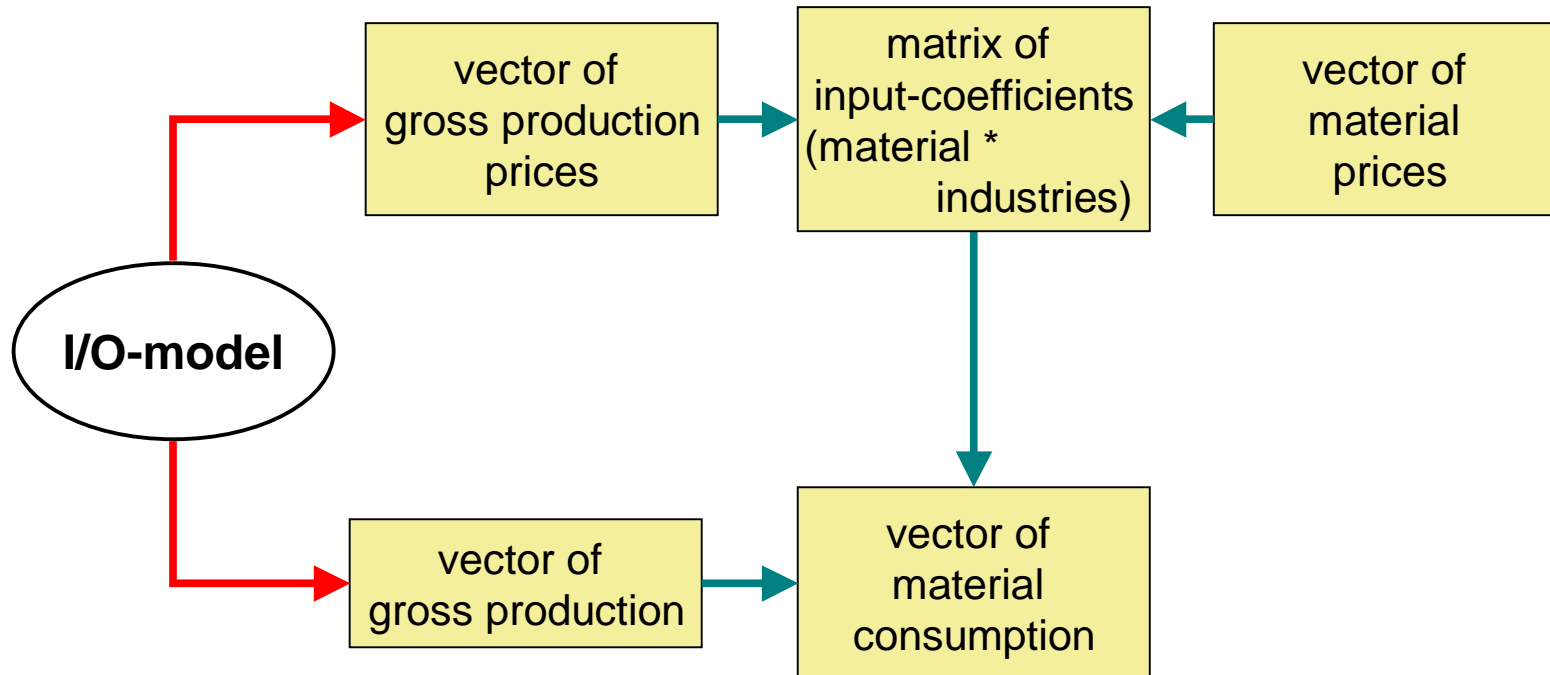
2 Labour market



2.4 Energy models



2.5 Material-Input-Model



3. Data restrictions and their handling

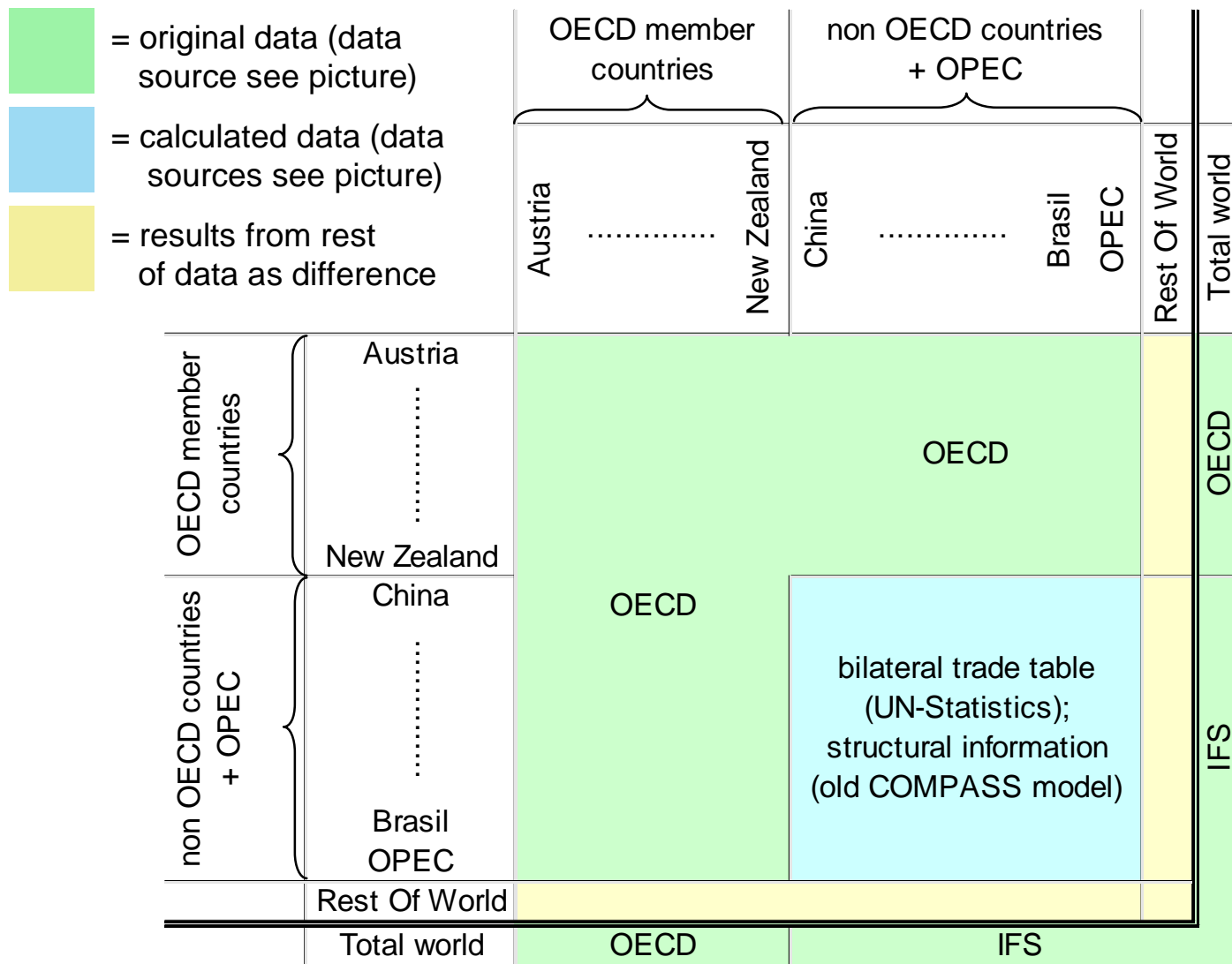
≈ general procedure

- full model specification not possible for all countries
 - è Missing data!
- if data is missing, two strategies are possible:
 - § introduce shortcuts in the specification and estimate reduced forms,
 - § or own data work to fill missing values !

≈ example for own data work

- completion of the OECD trade matrix

Bilateral trade matrix for commodity i in billions of US \$



4. Conclusions

- ≈ **Complete model will be available in about one year.**
Trade-model and macro-models (except SNA) are already finished
- ≈ Econometric estimation of the parameters gives a **realistic picture of the agent's behavior** under conditions of bounded rationality
- ≈ **Consistent global forecasts** for energy use, CO₂ emissions, material consumption and land use will be possible **with an endogenous development of the economy**
- ≈ Ability to calculate **global results for a country specific environmental policy**
- ≈ **Ability to show economic, social (partially!) and environmental consequences of European policy** for the different European countries and the world