Impact of Climate, Geography and Economic Structure of Each Country on CO_2 Emissions

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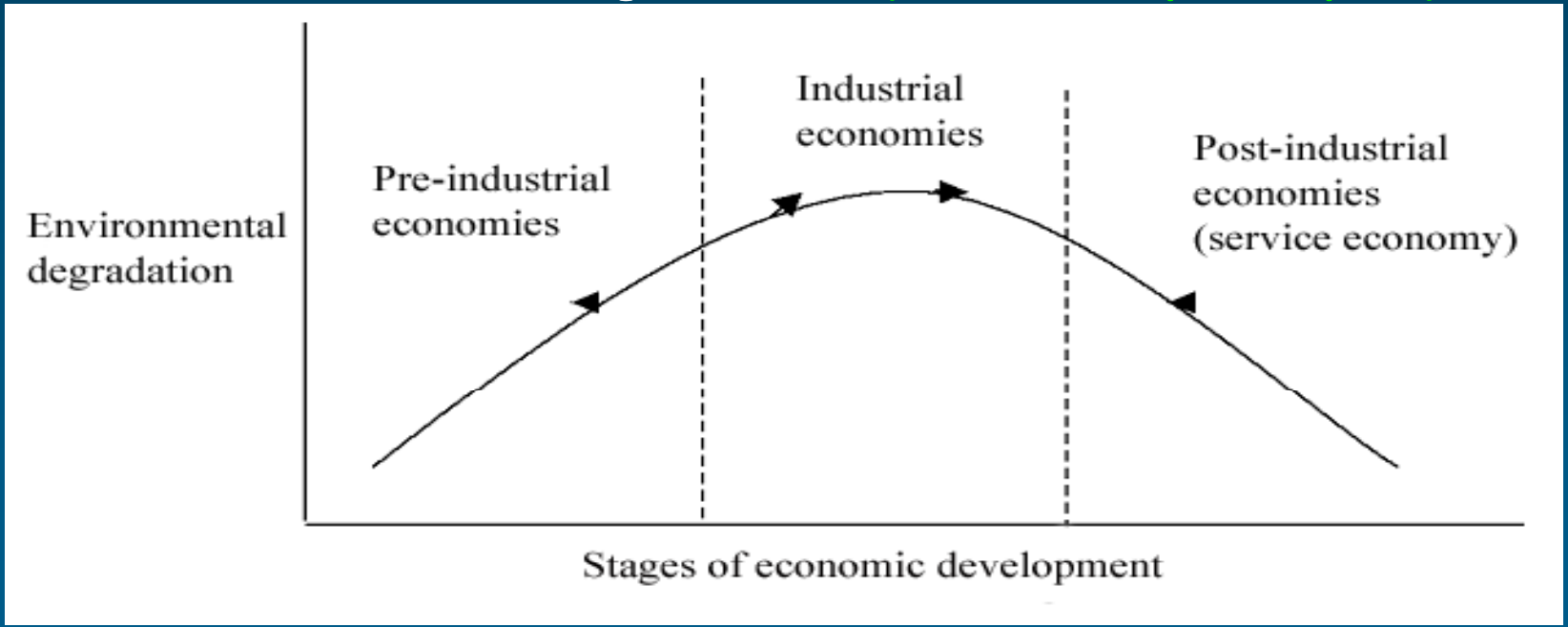
OBJECT OF THIS STUDY

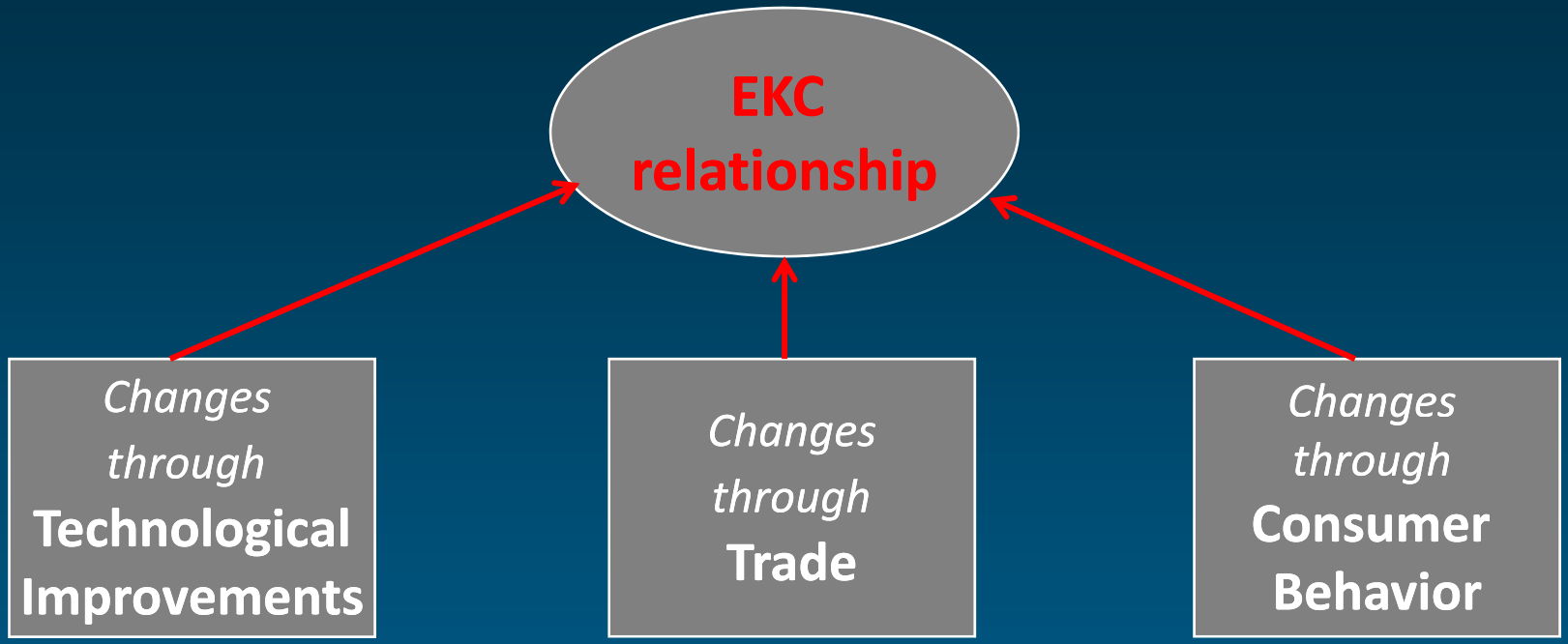
- To find the relationships between the environmental quality and the economic development of each country and detect special parameters that affect this relationship
- Main base: Environmental Kuznets Curve (EKC)

  →*Relationship between Economic Growth (Income per capita) and Environmental Degradation (Emissions per capita)*



An Environmental Kuznets Curve (EKC) in general

EKC in general



Other possible factors affecting the environment– income relationship:

income inequality, corruption,

investment on abatement policies,

income distribution - education - information access...

EKC for CO_2 emissions?

- Most of the studies for EKC hold for local pollutants but not for CO_2 emissions
- If EKC holds for CO_2 then economic growth would ultimately lead to a decrease of global emissions

But

- CO_2 is a major source of global warming
- Global nature of CO_2 emissions
- Agents in a particular economy cannot significantly affect global emissions and hence their own climate
- Over-accumulation of CO_2 emissions in the past
- CO_2 emissions are related with energy use which is an essential factor in the world economy for production and consumption

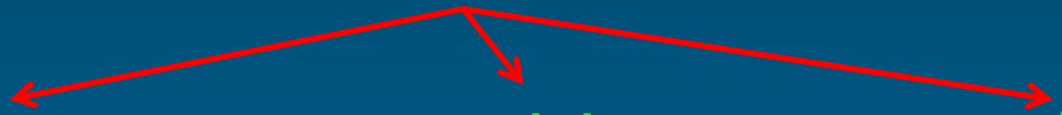
Points of Concern

- An EKC for CO_2 emissions in general is not robust enough
- We need to specify the particular characteristics of an economy that affect the growth process, its own environment and the global environment in general

PROPOSED METHOLOGY

Three categories of additional parameters

Must be taken into consideration



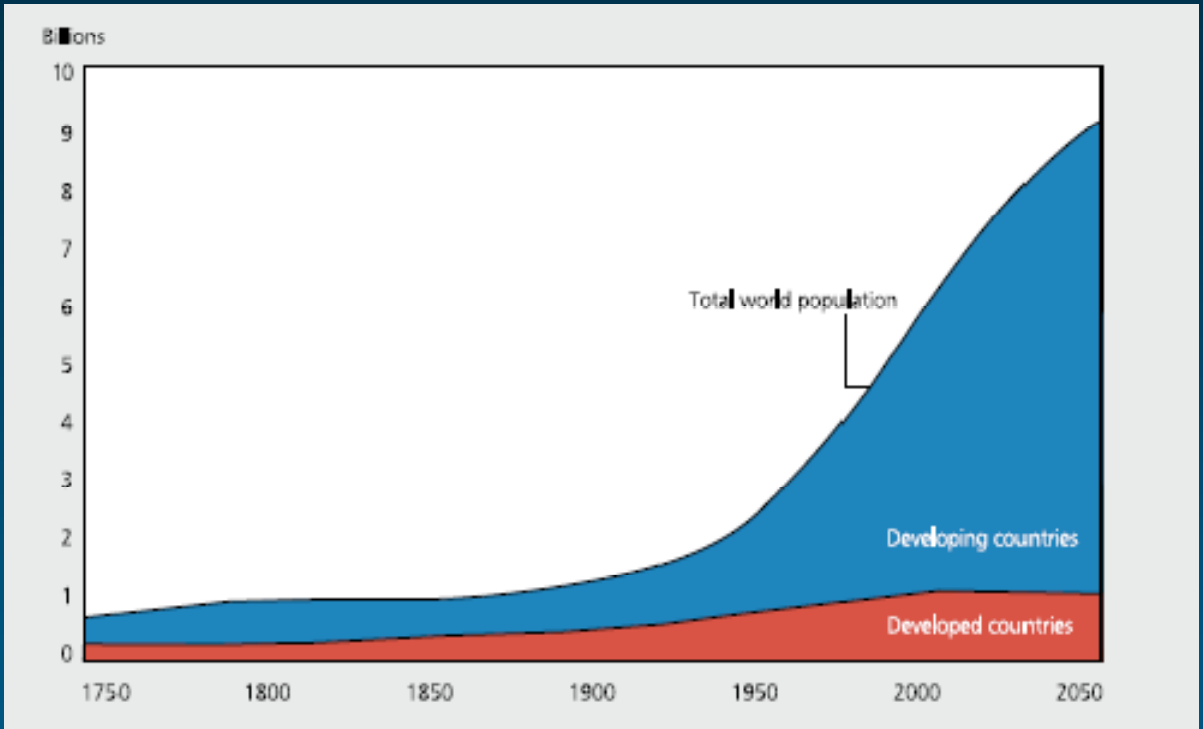
(A) **Geographical – Anthropo-geographical conditions**

(B) **Climate conditions**

(C) **Additional Economic parameters**

(A) Geographical, Anthropo-geographical Conditions

1. Population, Population growth



World Population 1750-2050
(United Nation)

- The biggest rate of population growth is expected to appear in developing countries
- Population plays an important role in CO_2 emissions

(A) Geographical, Anthropo-geographical Conditions

2. Urbanization rate

- Urbanization is connected with economic growth process
- Cities requires energy consumption, so urbanization is connected positively with increased CO_2 emissions (difference between developed and developing economies)

→ We need to examine

Existence of many but relatively small megalopolis

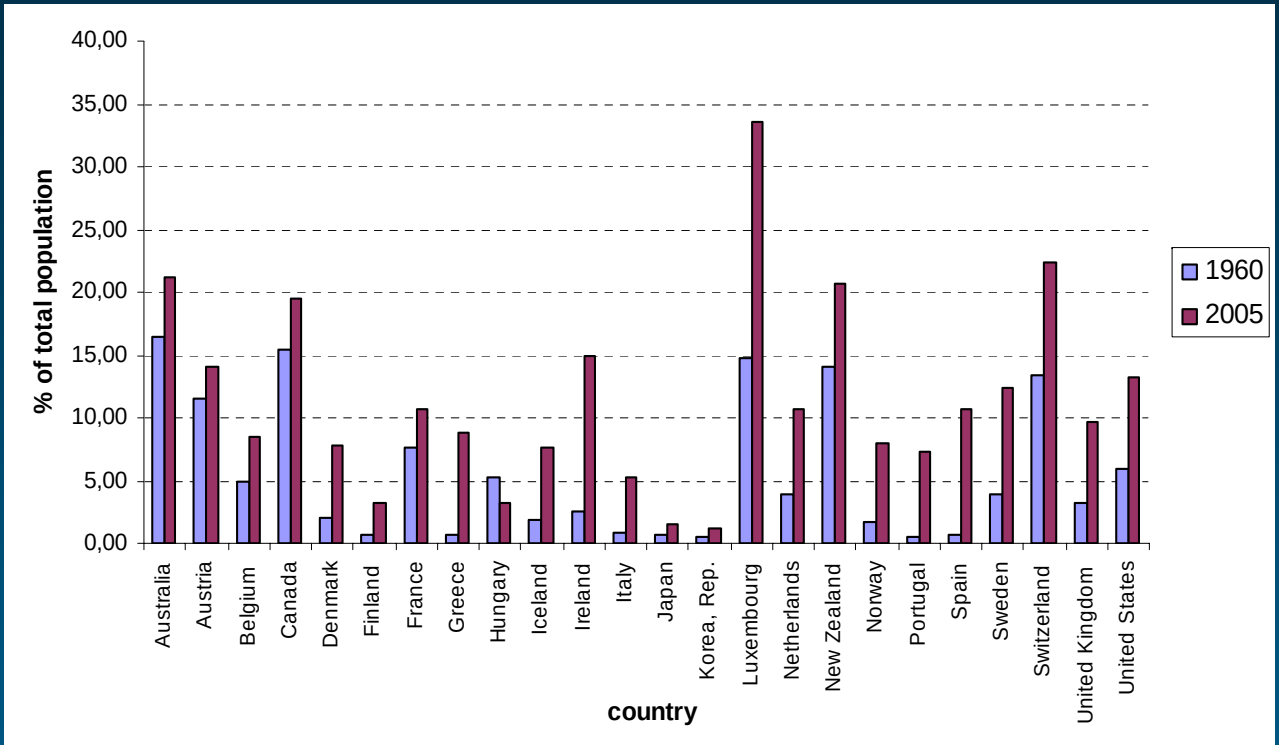
versus

Existence of little but relatively large megalopolis

- More effective in energy consumption terms
- More efficient transport infrastructure
- Apartment blocks – central heating systems
- Micro-climate changes

(A) Geographical, Anthropo-geographical Conditions

3. Migration



Migration as a % of total population in high-income OECD countries (World Bank)

- Migration can be limited by immigration laws, transportation cost, languages differences, lack of information about job opportunities
- Labour migrates from low to high-income countries

(A) Geographical, Anthropo-geographical Conditions

4. Sea Access – Tropical Geography

- Countries placed away from sea don't follow the usual economic development due to high transport cost.
- Tropical geography played a crucial role for the retarded development of the African economy

5. Other Geographical Conditions

- Surface (mountainous or flat), distance from markets, transport infrastructure
- Transport is responsible for ¼ of global energy-related CO_2 emissions
- Developing countries of Latin America: Growth of transport was associated with the increase of CO_2 emissions during the last years

(B) Climate Conditions

Average Annual Temperature

- Climate Changes → Increase of global average temperature
- Most of current scenarios estimate that the increase will overcome 1^{o}C till 2050, and 6^{o}C till 2100
- Warmer countries are in general “poorer”

Variations of Average Annual Temperature Locally

- Short - extreme increases of temperature →higher energy consumption due to the intensive use of air-conditioning systems
- Reversely, short-extreme decreases → lead to increased use of energy consumption for heating

→ *For example, warmer climate conditions in USA since 1982 slightly reduced carbon dioxide emissions , air-conditioning in Greece is one of the main fields of energy consumption during last years*

(B) Climate Conditions

Temperature Fluctuations and Economic Growth

- Developing countries are located in tropical areas and they are more vulnerable to extreme climate changes (floods, droughts, high temperatures,…). Their economy is mostly based on agriculture
- Countries in low latitudes start their growth with very high temperatures and further warming pushes them ever further away from optimal temperatures for climate sensitive economic sectors
- Vulnerability of poor countries because:
  - They are more exposed to climate changes
  - Their ability to face extreme climate changes (adaptive capacity) is limited by their low-income economies

(C) Economic Parameters – Economic Structure

1. Primary – Secondary – Tertiary Sector

Development Process: Agriculture → Industry → Services

% GDP	USA	CHINA	GERMANY	GREECE	GHANA	PAKISTAN
1970						
AGRICULTURE	3,54	35,21	3,67	13,20	46,51	36,83
INDUSTRY	35,22	40,49	48,08	32,84	18,22	22,32
SERVICES	61,23	24,30	48,24	53,95	35,25	40,84
2007						
AGRICULTURE	1,33	11,12	0,92	3,80	33,90	20,46
INDUSTRY	21,80	48,50	30,36	20,34	25,29	26,89
SERVICES	76,86	40,37	68,71	75,86	40,80	52,64

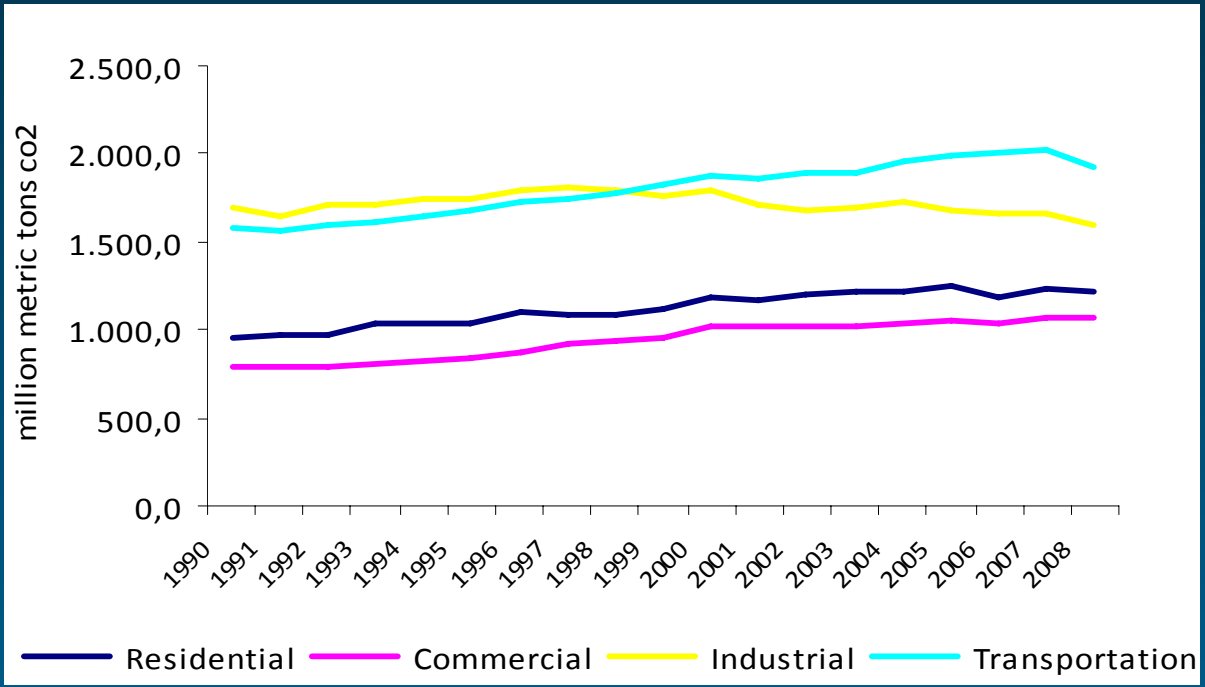
Distribution of GDP in 1970 and 2007 (World Bank)

So, what is happening with energy consumption that is connected with the productive sectors of the economy?

(C) Economic Parameters – Economic Structure

1. Primary – Secondary – Tertiary Sector

- Transportation is part of the services sector and is based on fossil fuels
  - For example, in USA:



USA energy-related CO_2 emissions by end use sector
(EIA 2009)

- Japan: Production of materials for the support and consumption of services led to increase energy use and increased CO_2 emissions

(C) Economic Parameters – Economic Structure

2. International Trade (Imports and Exports)

- Trade improves technology and help economies to develop their comparative advantage.
- Income inequality appeared in Mexico after trade reform
- Complicated environmental sequences of trade: production of goods to export or consumption of goods from imports rise the CO_2 emissions in an economy?

For example in

CHINA

Increase in production of products that exported in developed counties led to increased CO_2 emissions?

or

Increase in household consumption for energy intensive goods led to increased CO_2 emissions?

(C) Economic Parameters – Economic Structure

3. Energy use

- Energy use is a factor of economic growth
- Importance of energy mix (fossil fuels, nuclear, hydroelectric and others RES)
- Importance of energy prices (energy-depended economies are more vulnerable to energy shocks)

So, if we control energy use this will lead to controlling GHG emissions?

- A policy to reduce GHG emissions through energy consumption reduction is likely to have greater impact on the GDP of the developed rather than the developing world
- The solution could be the switch to renewable energy resources (?)

(C) Economic Parameters – Economic Structure

4. Reserves of natural resources

- Many countries rich in oil reserves, gas or tropical forests experienced low growth rate while many resource-poor countries experienced high growth rates
- Natural resource wealth increases growth if only negative indirect effects (corruption, low investment, low education standards,…) are excluded

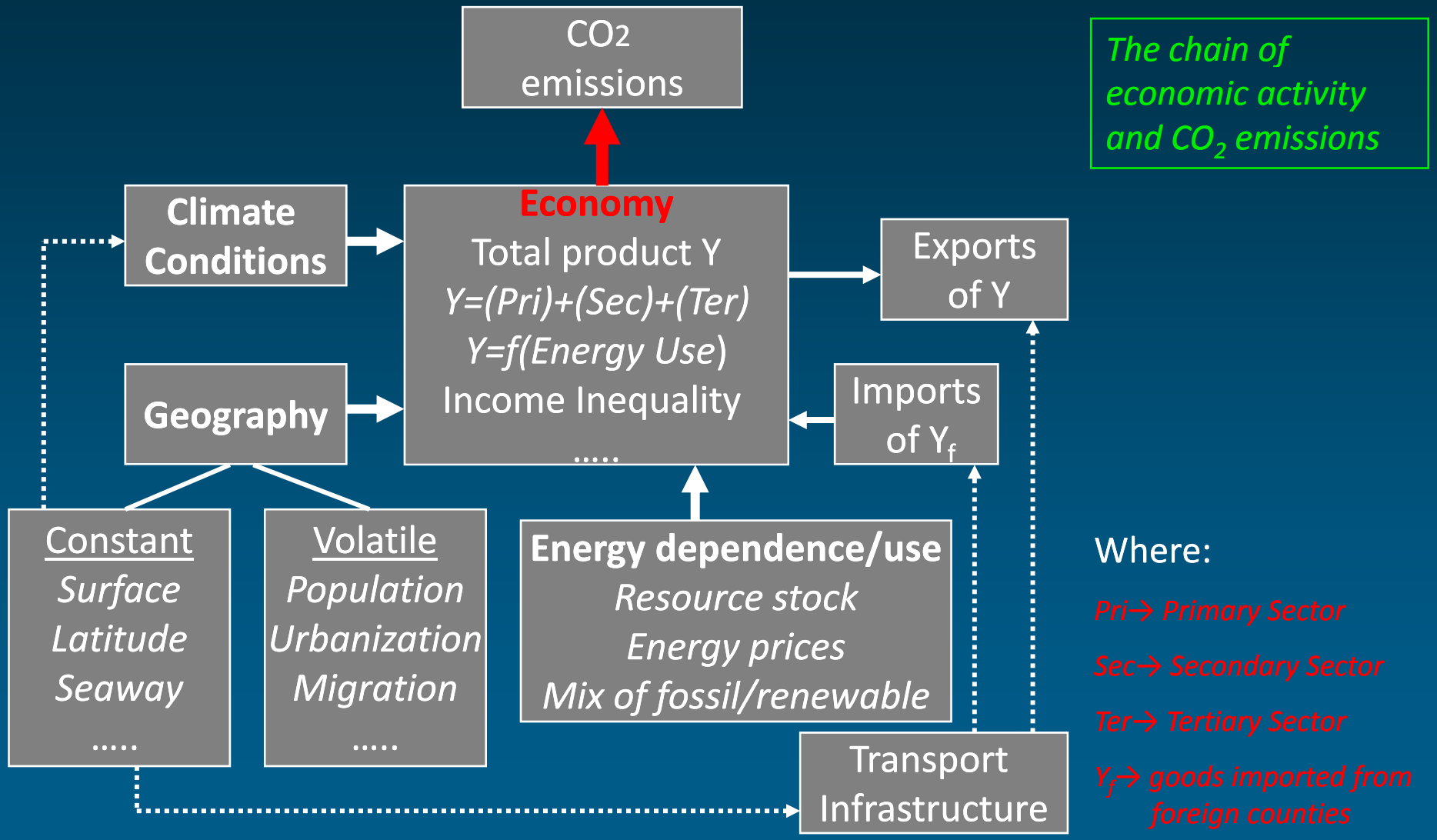
5. Income distribution

- Gap of income distribution between rich and poor habitants (percentage of people living in poverty, unemployment ,…)

→ *If an economy is stamped by high inequalities of income distribution, then environmental concerns will not be supported by people*

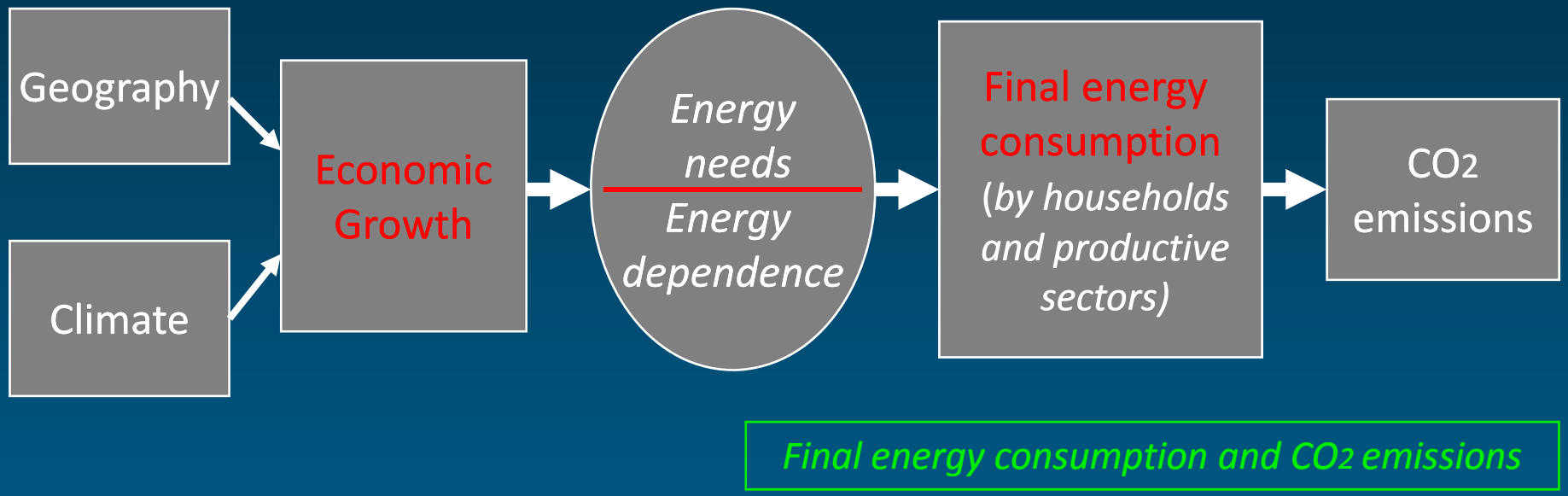
Generating a Model I

A basic general function implies that: $CO_2=f(Y,E,G,Cl)$



Generating a Model II

Another model can be applied to examine energy consumption:



- These models can be also applied on other gases such as SO_X and NO_X
- The models will be applied to counties from EE and OECD

CONCLUSIONS

- *Several parameters seems to affect the income (per capita) – environment (emissions per capita) relationship*
- *Parameters like geography, climate and economic structure should be included in order to provide a more realistic image of an economy as a whole*
- *Final target: proposition of some more accurate relationships in order to reveal an economy's impact on CO_2 emissions*

Impact of Climate, Geography and Economic Structure of each country on CO_2 emissions

By

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Thank you for your attention!