Modelling the Socio-Economic Implications of Climate Change: State of the Art in CGE Modelling and Challenges.

December 2021

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Features of Climate and Energy Policies

➢The clean energy transition is a <u>capital-intensive process</u> through which low value added products (fuels) are substituted by high value-added products and construction (Wind turbines, PV panels, Energy efficient appliances and machines).

➢Fossil fuel sectors decline, fuel import bills shrink but at the same time domestic investment expenditures increase

➢This process develops in a dynamic framework where prices, technology costs, production structures, consumer preferences and habits evolve requiring different and new types of labour skills, infrastructure and materials.

➢At the early stages of the transition financing requirements are high while the technologies and skills required to make the transition have not yet reached full learning potential – potential bottleneck

➢During this phase, it is possible that energy budget of agents (including all costs for energy services) increase compared to business as usual.

➢The policies and measures may act as conditions enabling positive externalities, which bring cost reductions and cost-efficient uptake of technologies

➢Competitiveness impacts are not static, as the industry transforms to produce the novel value-added products and materials. As for all technology-driven growth, first-mover advantages may drive competitiveness gains and export-driven growth.

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Channels through which the decarbonization of the energy system impacts the economy and employment

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DIRECT MULTIPLIER EFFECTS

IMPACTS

✓Increased **demand** for sectors that supply the materials/technologies necessary for the transition like:

➢ Energy efficiency (insulation, control, eco-design equipment),

➢ Renewables,

➢ Mobility equipment,

➢ Hydrogen and alternative fuels,

➢ Grids, networks and smart systems.

✓Reduced **demand** for carbon intensive and associated sectors:

➢ Fossil fuel extraction and mining,

➢ Oil refineries and oil distribution,

➢ Natural gas.

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✓Increase in production through demand driven effects (higher investments) from stimulus on domestically produced clean energy technologies

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✓Negative demand driven effects from lower production in conventional energy sectors

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INTERNATIONAL INDUSTRIAL COMPETITIVENESS

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✓ Increasing demand drives cost reductions through **economies of scale**, **learning by doing**, accumulation of knowledge and **spillovers**.

✓ If demand is sufficiently large the corresponding cost reductions can provide a comparative advantage to firms (increase profits and market share).

✓ Competitive firms producing advanced technologies act as a locomotive of growth for the rest of the economy

✓ EU ambitious GHG mitigation and RES policies set the size of a market which is characterised by intense international competition (EU demand may well be serviced by non – EU companies)

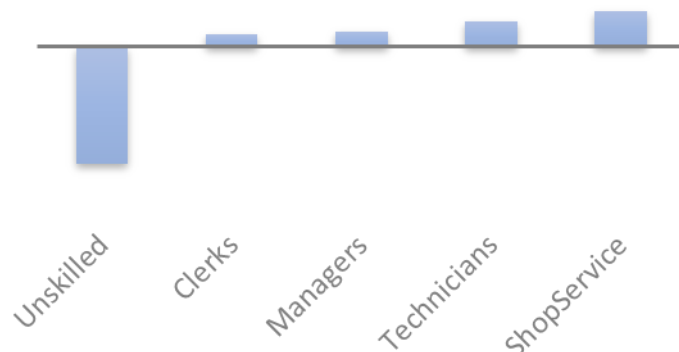✓ Use of expensive energy increases production costs for firms

+

✓ Price decrease through economies of scale, specialisation and vertical integration related to the production of alternative technologies and fuels.

✓ Positive effects due to increase in productivity enabled by energy efficiency.

✓ Improved current account.

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✓ Price increase if industrial production in the EU is driven by more expensive energy (commodities, grids, equipment) – Loss of competitiveness

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HOUSEHOLD, SKILLS & LABOUR MARKET

✓ The transition requires the availability of highly skilled labour (e.g. engineers, scientists, construction workers)

✓ Skills are connected with different levels of income and consumption patterns

✓ More expensive energy and high upfront costs imply a crowding out effect on family budgets in the early stages of the transition followed by economic gains due to energy bill savings thank to energy efficiency.

✓ Poverty effects may need focus

Unskilled Clerks Managers Technicians ShopService

IMPACTS

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✓ Increased demand for Highly skilled labour

✓ Increasing household income (for specific occupations) boosts consumption

✓ Upgrade of human capital increase diffusion of spillovers and productivity

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✓ Crowding out effects but cost savings in the longer term

✓ Unemployment Unskilled Labour

✓ Distributional Implications (energy and technology poverty)

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FINANCIAL MARKET

✓Cost of financing (interest rate) varies depending on the risk profile of the investment project and debt sustainability considerations.

✓Different financing conditions prevail for firms and households

✓Availability of low-cost financing impacts investment by sector and the dynamic effects on the economy.

✓Repayment of loans affect the dynamics of the economy

✓Low risk investment environment is required to attract direct foreign investment and fund raising
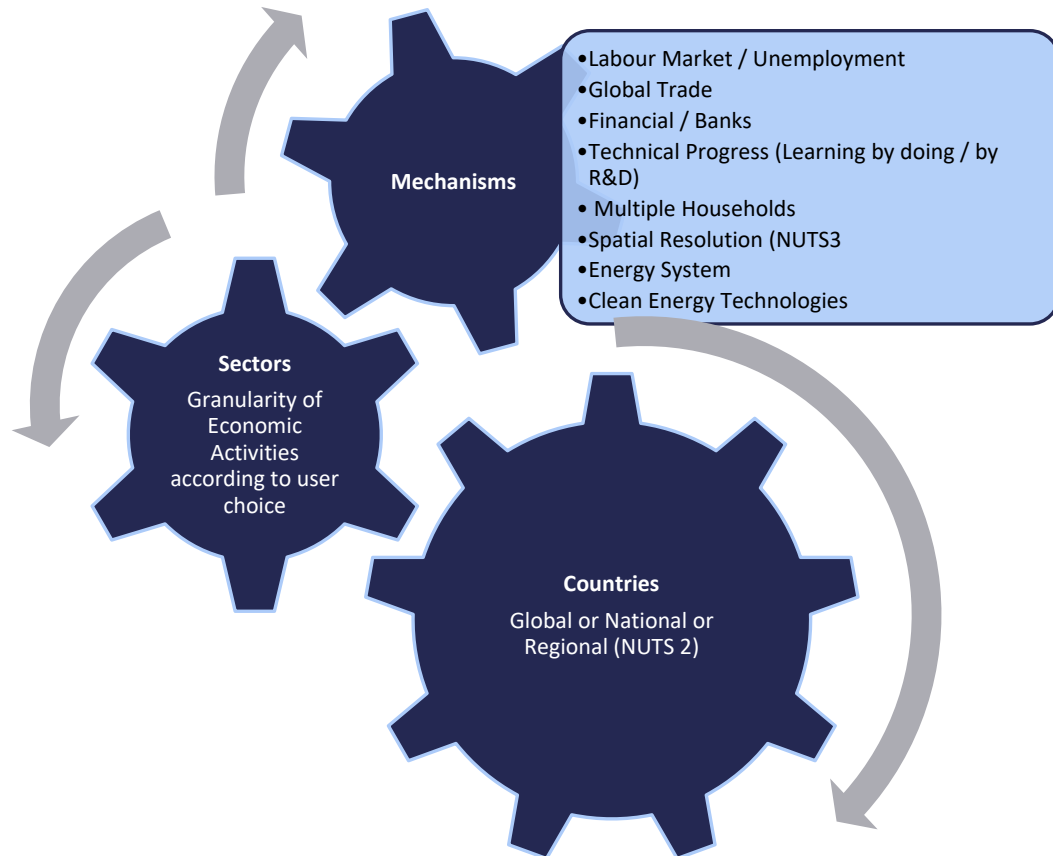
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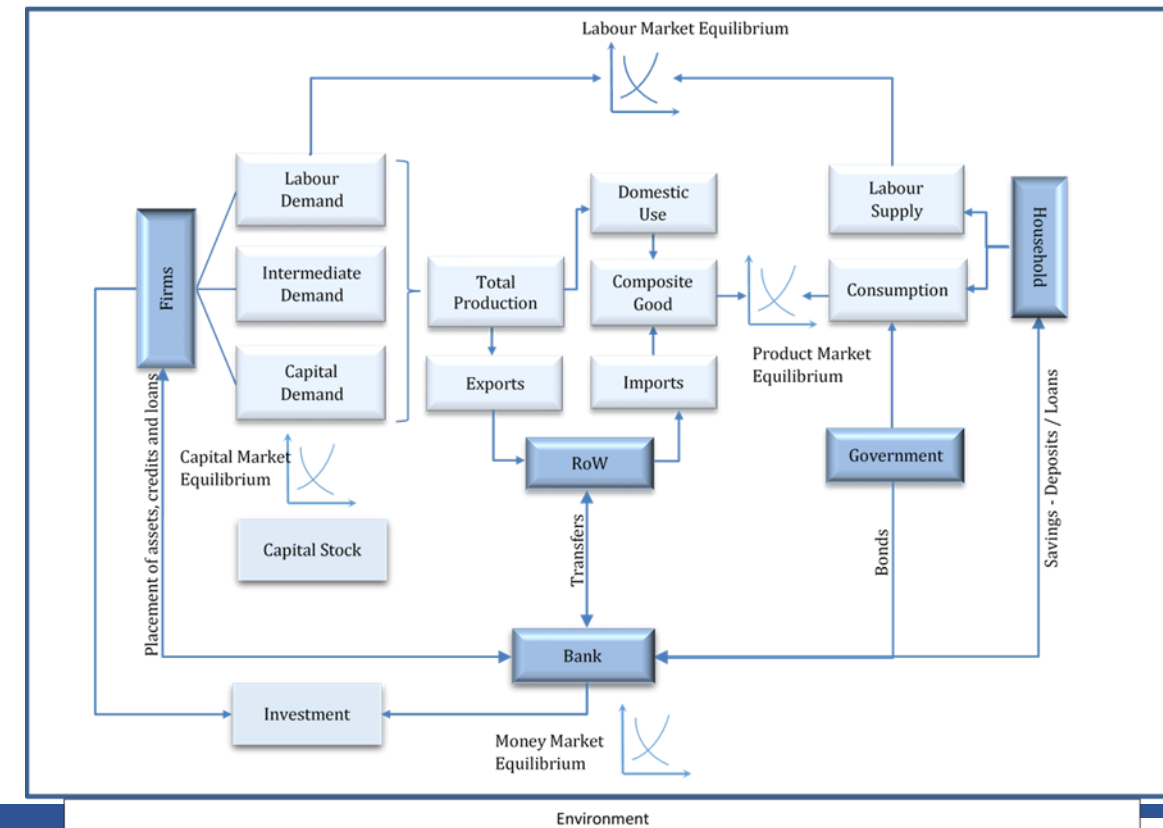**+**

✓Investment driven growth (demand stimulus effect)

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✓Debt and interest rate repayments reduce available income for investment and consumption

✓Significant crowding out effect when financing constraints/shortages apply

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CGE Modelling Scope

❖ CGE models capture the inter-dependencies of all economic agents and are built on sound microeconomic theory.

❖ Recent Advancements in CGE theory have enabled applied models to capture many more market aspects such as unemployment, imperfect competition, heterogeneity in economic agents' decision

❖ Sectoral Granularity is of major importance

Mechanisms
- Labour Market / Unemployment
- Global Trade
- Financial / Banks
- Technical Progress (Learning by doing / by R&D)
- Multiple Households
- Spatial Resolution (NUTS3
- Energy System
- Clean Energy Technologies

Sectors
Granularity of Economic Activities according to user choice

Countries
Global or National or Regional (NUTS 2)

State of the Art CGE Models - Selected Features

Explicit representation of the financial sector

Dixon et al (2015), GEM-E3

Technical change and innovation-induced growth

GEM-E3, Christensen et al 2015

Endogenous Supply of human capital

LIM et al (2015)

Human capital & ability to absorb/generate knowledge

Bretschger et al (2015)

Explicit representation of infrastructure

Lofrgen (2021)

Unemployment, Multiple Households

Boeters (2013), Rutherford (2004), GEM-E3

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Thank You