IMPERFECT MARKETS AND THE PROPERTIES OF MACRO-ECONOMIC-ENVIRONMENTAL MODELS AS TOOLS FOR POLICY EVALUATION

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1. Introduction

Introduction

➢ Input-Output analysis is an essential tool to understand the relation between economic development and the extraction of resources and the emissions of pollutants.

➢ The open Leontief model is too simple, a system is needed that endogenizes final demand and primary inputs.

➢ I/O theory offers all that, developing linear models with constant coefficients, independent prices and volumes.

➢ But how to implement economically acting agents in such a framework?

Two answers:

- Johansen (1960): First **CGE** model
  - ✓ Theory: neoclassical: perfect markets
  - ✓ Parameterization: by assumption / calibration with one data point
- Almon (1967): First integrated I/O and macro-econometric **ME**
  - ✓ Theory: keynesian: imperfect markets
  - ✓ Parameterization: econometric

Introduction

➢ Central question of economy-environment (EE) models: How to reach more sustainability?

  • Integration of economic, social and environmental indicators necessary,

  • Huge models: global, deep country, sector, product, resource and pollutant dimensions

➢ CGE type EE models became the typical "work horses" of environmental policy assessment. Reasons:

  • Success of neoclassical theory (neoclassical revolution),

  • Easy handling

➢ State of the art: deficits concerning social and environmental indicators

  • CGE models: Link with social and natural science models (Böhringer and Löschel 2006).

  • ME model GINFORS: Link with vegetation model LPJmL (Beringer et al. 2011) and material model World (Sverdrup et al. 2012)

Introduction

➢ Objective of the paper at hand:

- No critical assessment of the two model types. This has already been done for CGE models by Grassini (2007).

- **What is the impact of market imperfections on modelling results?**

Structure of the paper

Chapter 2: How to model market imperfections in a macroeconomic context?

    ✓ Meeting the literature of the "Neokeynesian counterrevolution"

Chapter 3: The Capros experiment.

    ✓ Comparing simulation results with two specifications of one econometric models differing only in terms of market organization.

Chapter 4: Discrepancies between the reference scenarios: The problem of exogenous growth in CGE modeling.

Chapter 5: Comparison of results from EXIOMOD (CGE) and GINFORS (ME) in the POLFREE project

Chapter 6: Conclusions

2. How to model market imperfections in a macroeconomic context?

Modeling market imperfections

➤ **Keynes: Imperfections on the labour market and the capital market:**

- <u>Labour market:</u> Nominal wage rate is the result of a bargaining process and constant in the short run. Real wage rate higher than the equilibrium rate.

- <u>Capital market:</u> Incomplete information of lenders and borrowers does not allow that savings determine investment as neoclassical theory claims.

➤ **Neokeynesian theory introduces micro foundations for these two imperfections and adds stickiness of goods prices.**

- <u>Labour market:</u>

  - ✓ Interpretation of the Phillips-curve by Samuelson and Solow (1960): Long run nominal market wage rate is determined in a bargaining process depending from price level, labour productivity and rate of unemployment. Strong unions realize higher than equilibrium rates

  - ✓ Efficiency wage theory (Stiglitz 1976): Higher wages raise efforts of employees and reduce labour turnover. Firms set wage rates for their firms above the equilibrium level. Yellen (1984) discusses variants.

Modeling market imperfections

- Capital market:
  - ✓ Neoclassical position: Full employment determines production, closure rules (Sen 1963) guarantee that total demand equals production: Supply side dominates:
    - Neoclassical closure in a closed economy: Savings determine top down total investment, sectoral structure depending from returns.
    - Open economy: closure rules are modified by external surplus (Taylor and Lysy 1979, Dewatripont and Michel 1987)
  - ✓ Neokeynesian position: There is no need for a closure rule because of unemployment.
  - ✓ Modelling of investment in Neokeynesian models: Bottom up accelerator-hypotheses
    - Optimal capital output ratio depending from user costs of capital.
    - investment depending from the optimal change of the capital stock.

Discrepancy between neoclassical and neokeynesian solutions

➢ **Simplified typical neoclassical recursive macro structure**

➢ For simplicity: Exogenous labour supply
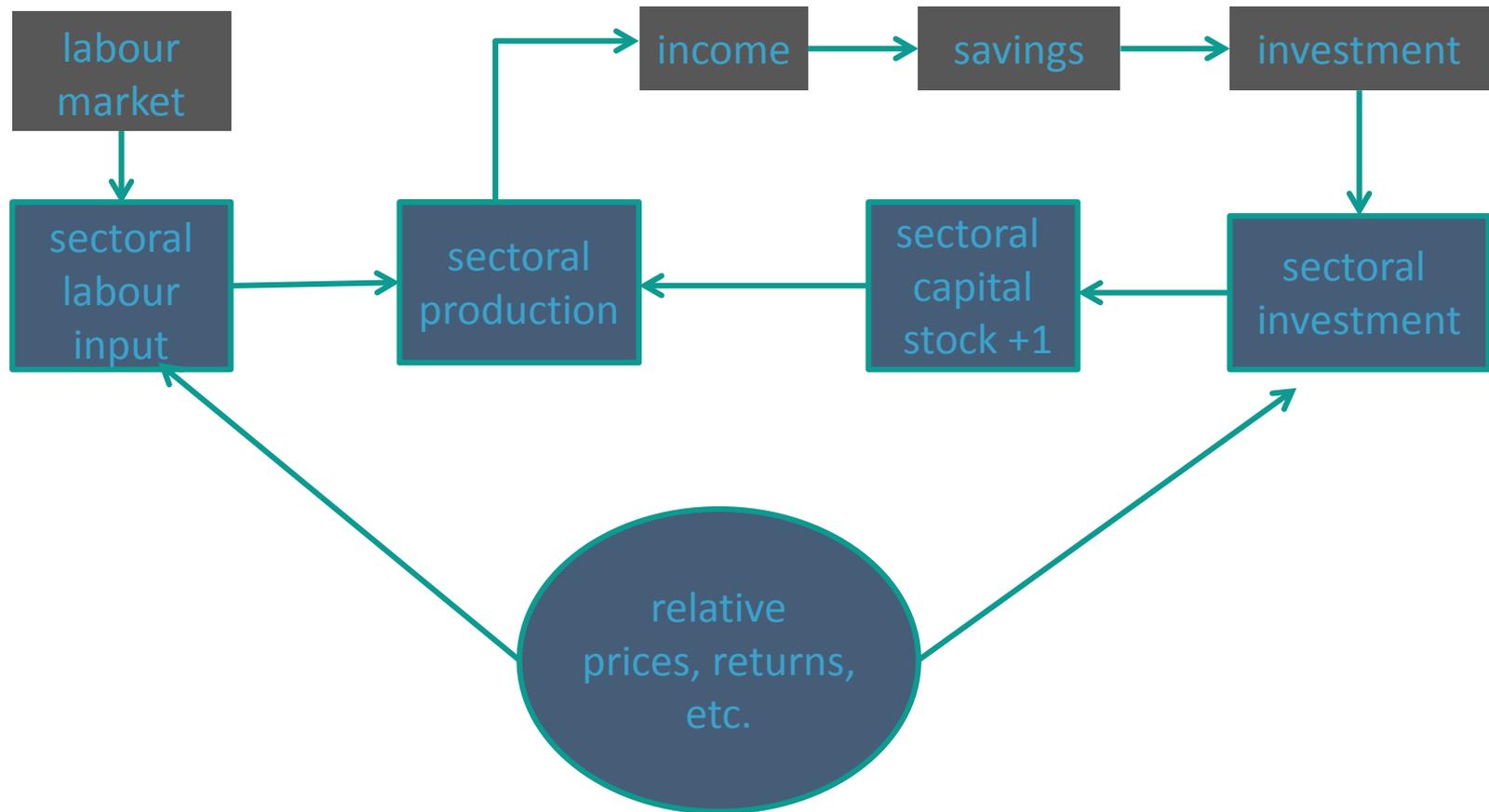
Discrepancy between neoclassical and neokeynesian solutions

> **Simplified typical neokeynesian macro structure: complex multiplier-accelerator interaction**

> For simplicity: exogenous labor supply
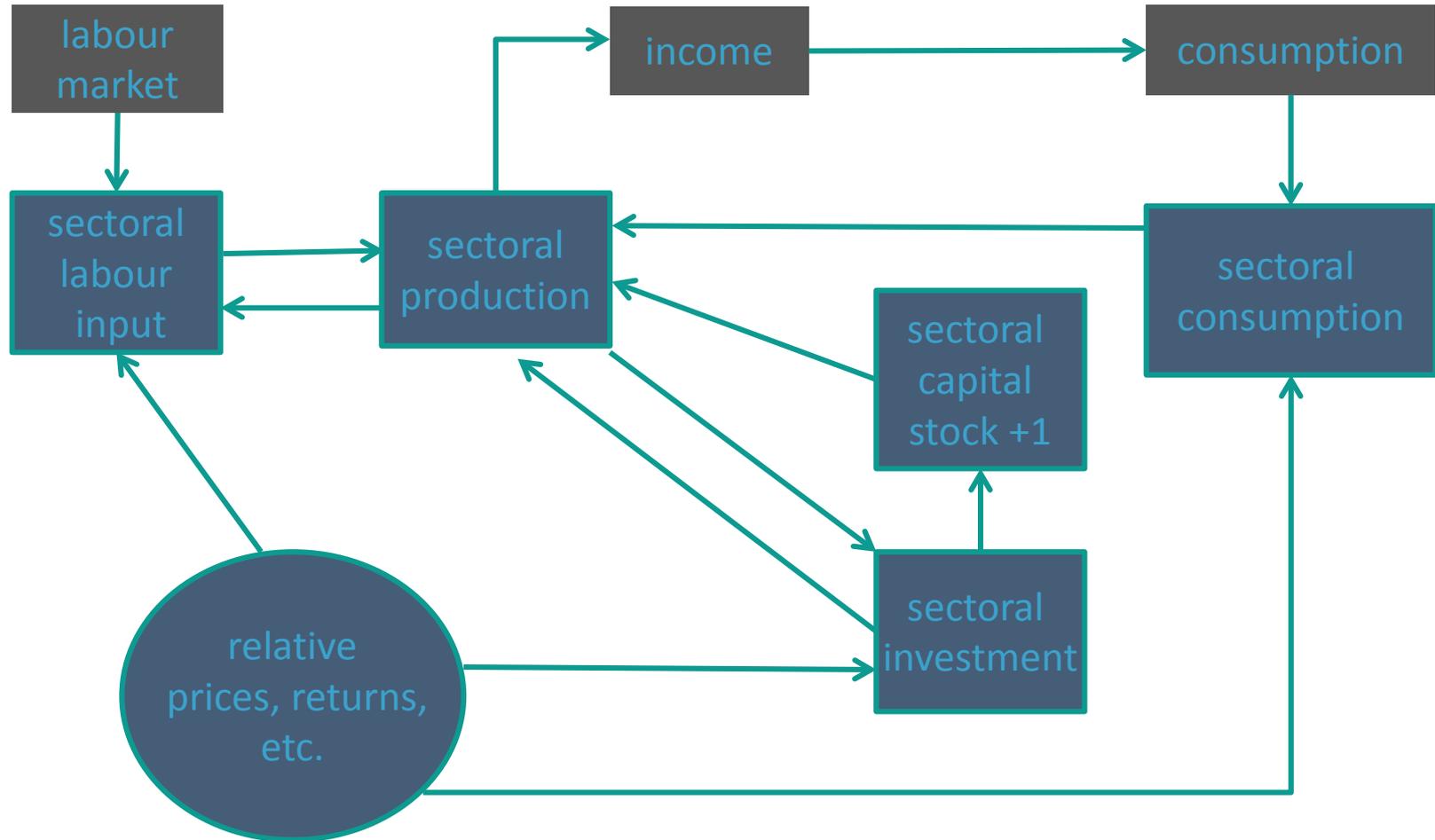
Modeling market imperfections

- <u>Goods markets</u>
    - ✓ Neoclassical position:

        Under conditions of perfect competition the sectoral supply curve is the aggregate of marginal cost curves of the firms. The market price equilibrates supply and demand:
        A fall of demand induces a fall of the market price.

    - ✓ Neokeynesian position:

        Stickiness of prices in relation to demand.

        - – Akerloff and Yellen (1985): Under monopolistic competition already small menu costs of a price change can make price stickiness profitable.

        - – Romer (1993) discusses four effects that influence this result.

        - – Blinder (1994) presents 12 different micro foundations for price stickiness and presents results for empirical evidence.

Modeling market imperfections

– Stiglitz (1984): "In *these theories firms behave all "rationally";*

– *an alternative "explanation" of seeming price rigidities is that* firm's managers act according to certain rules of thumb, for example, those that entail a mark-up over average costs. *Though such "theories" – if they can be called that – fail to explain how or when mark-ups change, as they undoubtedly do,* they may provide as good a description of the short run behavior of the firm as our more sophisticated theories".

Meaning for impacts of environmental policy

➢ **Impact of reductions of demand**
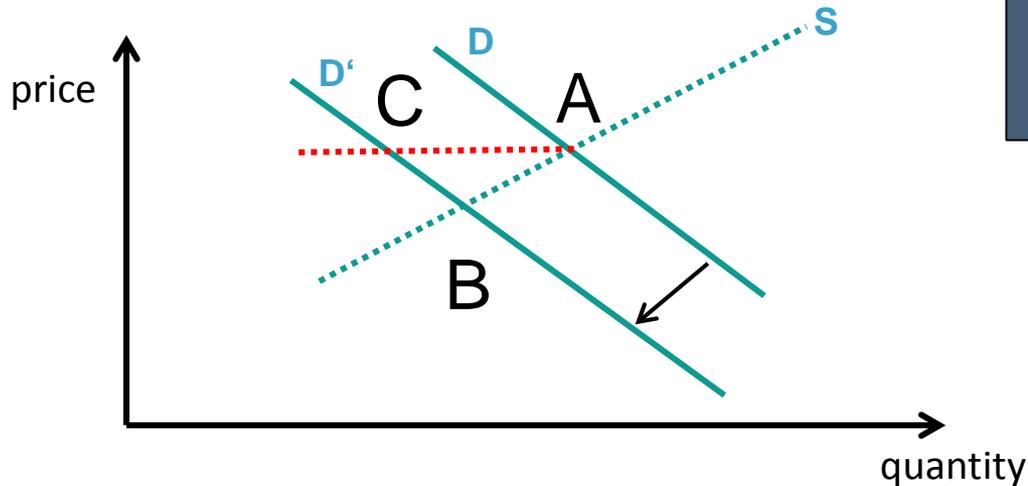
A: start
B: neoclassical
C: neokeynesian solution

➢ **Impacts of reductions of supply (higher costs)**
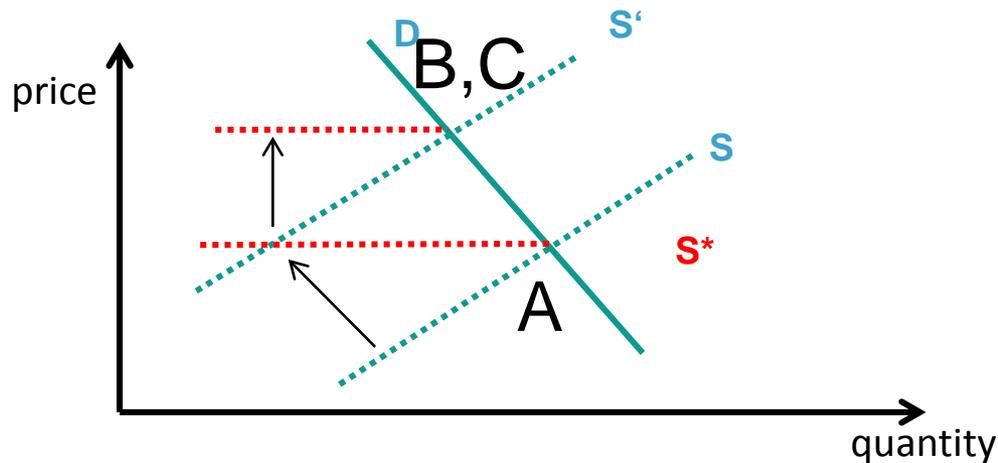
Meaning for impacts of environmental policy

> efficiency gains on labor productivity
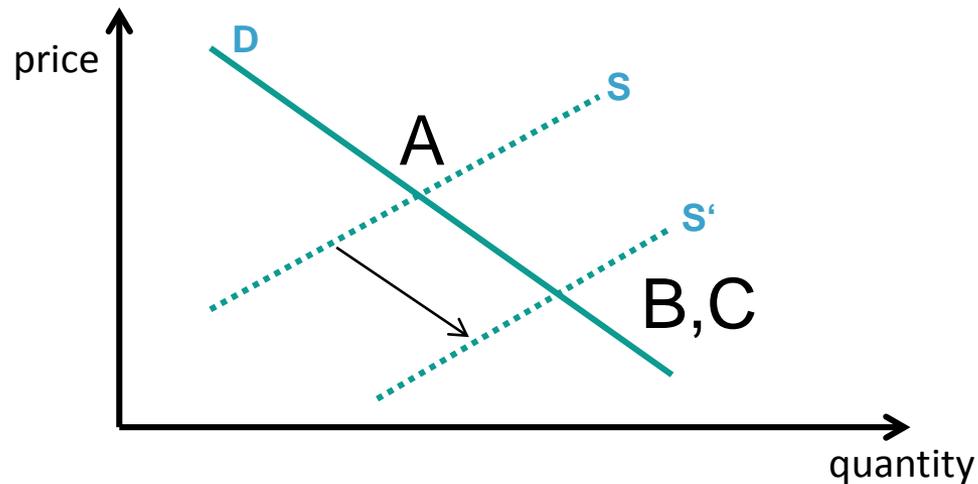
A: start
B: neoclassical
C: neokeynesian solution

- – Sectoral effects similar,
- – Direct effects on labor inputs
  - ▪ Neoclassical case: zero
  - ▪ Neokeynesian case: negative
- – GDP effects:
  - ▪ Neoclassical case, rise of production and GDP.
  - ▪ Neokeynesian case: unclear, probably negative.

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Meaning for impacts of environmental policy

➢ Impact of policies inducing investment

  – Direct sectoral effects similar,
  – Indirect effects on sectoral investment:
    ▪ Neoclassical case: negative
    ▪ Neokeynesian case: positive
  – GDP effects:
    ▪ Neoclassical case: zero.
    ▪ Neokeynesian case: positive.

3. The Capros experiment

The Capros experiment

➢ Instrument: Econometric estimation of the World Bank Model (De Melo 1988) for Greece 1965 – 1985. Macroeconomic, open economy.

➢ Two specifications: Neoclassical and neokeynesian

➢ Simulation of shocks:

  • Increase in public investment,

  • Increase in technical progress,

  • Income taxation,

  • Value added taxation,

  • Increase in foreign prices,

  • Increase in foreign demand,

  • Liberalization of foreign trade.

➢ Here selection:

  • Increase in public investment,

  • Increase in technical progress,

  • Value added taxation,

The Capros experiment

➢ **Increase in public investment**

- Neoclassical specification:
  - Rising public investment without additional savings means a reduction of private investment, capital stock and production.
  - Lower production, income, savings and investment.

- Neokeynesian specification:
  - Higher public investment raises demand and production, income and consumption: Positive multiplier-accelerator process.
  - Higher income.

➢ **Increase in technical progress**

- Neoclassical specification:
  - Supply curve shifts to the right, prices fall, production rises, income rises, savings, investment and capital stock rise inducing a further expansion of production.

- Neokeynesian specification:
  - Production costs reduce, prices fall, lower capital stock reduces investment, lower labour input reduces income and consumption.
  - Negative effects are stronger than expansion triggered by falling prices.

The Capros experiment

- ➢ **Value added taxation**
  - • Neoclassical specification:
    - – Higher tax rate raises prices, demand reduces, but on the other side savings (of the government) rise pushing investment, the capital stock, production and income etc.
  - • Neokeynesian specification:
    - – Higher tax rate raises prices, demand reduces, production, income, consumption and investment reduce (negative multiplier-accelerator process).

- ➢ **Result:**
  - • In all cases opposite impacts on GDP
  - • Employment effects are also contrary because unemployment is not existing in the neoclassical case.
  - • Also in most of the other simulations of the Capros experiment the impacts are contrary.

4. Discrepancies between the Reference Scenarios:

The Problem of exogenous Growth

Discrepancies between the Reference Scenarios

- Construction of baselines in neokeynesian models: Model simulation based on the following inputs:

    - Forecast for exogenous variables,

    - "business-as-usual" policy assumptions.

- Missing empirical validation of CGE models often prevents the construction of a reasonable baseline: Adaptation of plausible forecasts or results from other models. Fontagne et al. (2013) give a literature overview.

- Procedure acceptable, if only deviations from the baseline as the result of policy simulations are questioned.

- Procedure not acceptable, if levels of variables are discussed in both baseline and alternative scenarios, because the level for the baseline is not a result of the CGE model in question.

- Dixon and Rimmer (2012) demand to improve the ability of CGE models in forecasting, because policy makers are more and more interested in levels of scenario variables.

- Further comparison of level results between CGE and ME models are complicated.

5. Comparison of Simulation Results:

EXIOMOD (CGE) and GINFORS (ME)
in the POLFREE Project

Comparison of Simulation Results

➢ Central research question of the POLFREE project: How to reach the environmental targets of the vision for Europe till 2050?

- CO_2 emissions reduction by 80% compared with 1990,

- reduction of the cropland footprint by 30 % compared with 2005,

- raw material consumption 5 tons per capita,

- water exploitation index below 20% in all EU countries

➢ Parallel use of two global economic environmental models EXIOMOD (TNO) and GINFORS (GWS) both linked with the global vegetation model LPJmL (PIK).

➢ Scenario framework (Jäger and Schanes 2014) which defines in addition to the EU targets the cooperation in the other countries of the world and allocates plausible policy mixes (Wilts et al. 2014) to different assumptions on governance (O'Keeffe et al. 2014).

Comparison of Simulation Results

➢ **Business-as-usual:**

– EU: the already implemented climate policy is maintained, no activities to reduce material extractions are taken.

– Non-EU countries: No environmental policy action at all.

➢ **Global Cooperation:**

– global agreement on the common use of 30 policy instruments, mix of regulations, economic and information instruments.

– In addition to EU targets:

- 2 degree climate target,

- resource use (raw material, water, cropland) targets of the EU accepted in global scale.

➢ **EU Goes Ahead:**

– Non EU countries: only a moderate climate policy.

– Full program as in Global Cooperation, some changes in the policy mix to avoid problems with competitiveness.

➢ **Civil Society Leads:**

– Non-EU countries as in EU Goes Ahead.

– EU countries: supply side instruments substituted by change of demand based on intrinsic motivation of consumers.

Comparison of Simulation Results

➢ **Comparison of baseline results not useful:**

Only GINFORS produced a "business-as-usual" forecast, EXIOMOD is calibrated on the CEPII EconMap v2.2 data.

➢ **Comparison of results for the alternative scenarios:**

- <u>Environmental targets:</u>
  GINFORS meets the targets, EXIOMOD is far away.
  Reasons:

  – Neoclassical market clearing creates danger of strong rebound effects

  – Specific EXIOMOD price elasticity assumptions:

    ✓ Price elasticity for intermediate demand zero: Taxation of resource intensive goods has no direct substitution effect.

    ✓ Policies reducing final demand shift demand curve to the left, producer price falls equilibrating demand and supply. Reduction of production lower as in the case of sticky prices.

    ✓ Price elasticity of consumption goods: **-1**: Instruments pushing innovation shift supply curves to the right generating a new equilibrium with lower prices and higher demand and production: rebound effect.

Comparison of Simulation Results

- Price elasticity for imported goods: **-5**: Efficiency gains reduce prices which lowers imports and raises domestic production and value added.

✓ GINFORS:

- Policies to reduce final demand shift demand curves to the left, stable producer prices mean full reduction of production.

- All parameters are econometrically estimated.

- <u>Economic effects</u>

✓ EXIOMOD:
Neoclassical closure prevents a positive impact because investment in new technologies displaces other investment activities on the capital market.

✓ GINFORS:
Investment in new technologies induces a multiplier-accelerator process, which pushes GDP and employment in Global Cooperation and in EU Goes Ahead.

6. Conclusions

Conclusions

Neoclassical paradigm:

➤ **Perfect labour market**: Clearing of the labour market determines labour input,

- full employment,

- capital input given from decisions of the previous periods: Production is determined.

➤ Total Demand has to be restricted to total supply:

- Closure rules

- **Perfect capital market**: Neoclassical closure: Savings determine investment.

- Policy induced investment will always displace other investment, no effects on GDP.

➤ **Perfect goods markets:**

- Policies reducing demand shift curve to the left, a fall of the producer price equilibrates demand and supply and diminishes the reduction of demand: danger of strong rebound effects.

- Policies reducing supply create a new equilibrium with a higher price and a lower production.

- Efficiency gains shift supply curve to the right, falling price creates higher demand and production

Conclusions

Neokeynesian paradigm:

➢ Labour market: Unemployment

➢ Capital market: Sectoral investment depending from the change in sectoral production, equilibrium of the circular flow of income implies equilibrium of the capital market (I = S). A rise of investment induced by policy creates a positive multiplier-accelerator process.

➢ Goods markets:

- Policies reducing demand mean a stronger reduction of production than in the neoclassical case, since the producer price does not fall, it even might rise.

- Policies reducing supply (raising costs) create a higher price and a lower demand. Effects similar to that of the neoclassical case.

- Policies inducing efficiency gains reduce price and raise demand and production. Sectoral effect similar to the neoclassical case, but reduction of labor and capital inputs reduce production and income.

Conclusions

effects on unemployment: just opposite

➢ Neoclassical paradigm: impossible

➢ Neokeynesian paradigm: generally possible, direction depends on the applied policy mix

effects on GDP: just opposite

➢ Neoclassical paradigm: positive effects only possible with

- Rise of savings,

- Technical progress

➢ Neokeynesian paradigm

- Positive effects possible by a rise of investment or any other component of final demand,

- Technical progress

  - Intermediate inputs: probably positive effects

  - Labour and capital: probably negative

Conclusions

Danger of strong rebound effects: all other things equal, greater in the neoclassical paradigm

➢ No general findings (Sorell 2007), depending from policy mix, indirect effects, numerical values of price and income elasticities (see EXIOMOD, GINFORS example) **and** market structure.

➢ Policies affecting the supply have in both paradigms similar effects on production, result depends on numerical values of price elasticities.

➢ Policies affecting the demand side have only in the neoclassical paradigm strong rebound effects.

Thank you very much for your attention.

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