# General Equilibrium Modelling of Energy Environment with Taxes in the UK (GEMEETUK)

**PLANS FOR EXTENSION**

**EU**

**OECD**

**LDC**

# Project aims & plan:

- Develop the UK , EU and developing economy Models to take proper account of environmental costs and its impact on long run growth, redistribution and welfare of households
- **How will this proposal lead to award of external funding?** (please be specific)**:**
- Papers coming out from the project will be used for writing proposals and grants. I have already made 400k application to ESRC. This can be to EPSRC for continuation of SUPERGEN


Cold
Series

# Provide indication of any interdisciplinary elements to the proposed project:

- Economic modelling is concerned with both social and behavioural sciences in the consumption side and natural sciences in technological side.

- reference to 3-5 high impact papers.


- Bhattarai K. and J Whalley (2003) Discreteness and the Welfare Cost of Labour Supply Tax Distortions, *International Economic Review* 44:3:1117-1133, August 2003.
- Bhattarai K and J Whalley (2006), Division and Size of Gains from Liberalization of Trade in Services, Review of International Economics, 14:3:348-361.
- Bhattarai K. (2001) “Welfare Gains to UK from a Global Free Trade” *the European Research Studies*, Vol. IV, Issue 3-4, 2001.
- Bhattarai K (2005) Consumption, Investment and Financial Intermediation in Ramsey Models, Applied Financial Economics Letters, Applied Financial Economics Letters 1(6), 1-5.
- Bhattarai K. “Welfare Impacts of Equal-Yield Tax Experiment in the UK Economy”, Applied Economics forthcoming.
- Bhattarai K., “An Empirical Study of Interest Determination Rules”, Applied Financial Economics, forthcoming.

**Provide indication of how the proposed project would help in the career development of staff at Hull.**

- It will provide some support for
  - conference attendance,
  - to renew membership to professional organisations and
  - to pay submission fees to journals.
  - to pay for research students.

# Total Cost of project = £60000

- Student researcher 20000
- Travel/professional contact 30000
- Submission to journal 5000
- Membership to professional bodies 5000

For small grant divide all by 10 : £6000

# Dynamic GE Model Energy and Environment of the UK economy (GEMEETUK)

- Consumption
  - 10 categories of representative household
  - Investor
  - Trader
  - Government
- Labour-leisure choice and labour supply

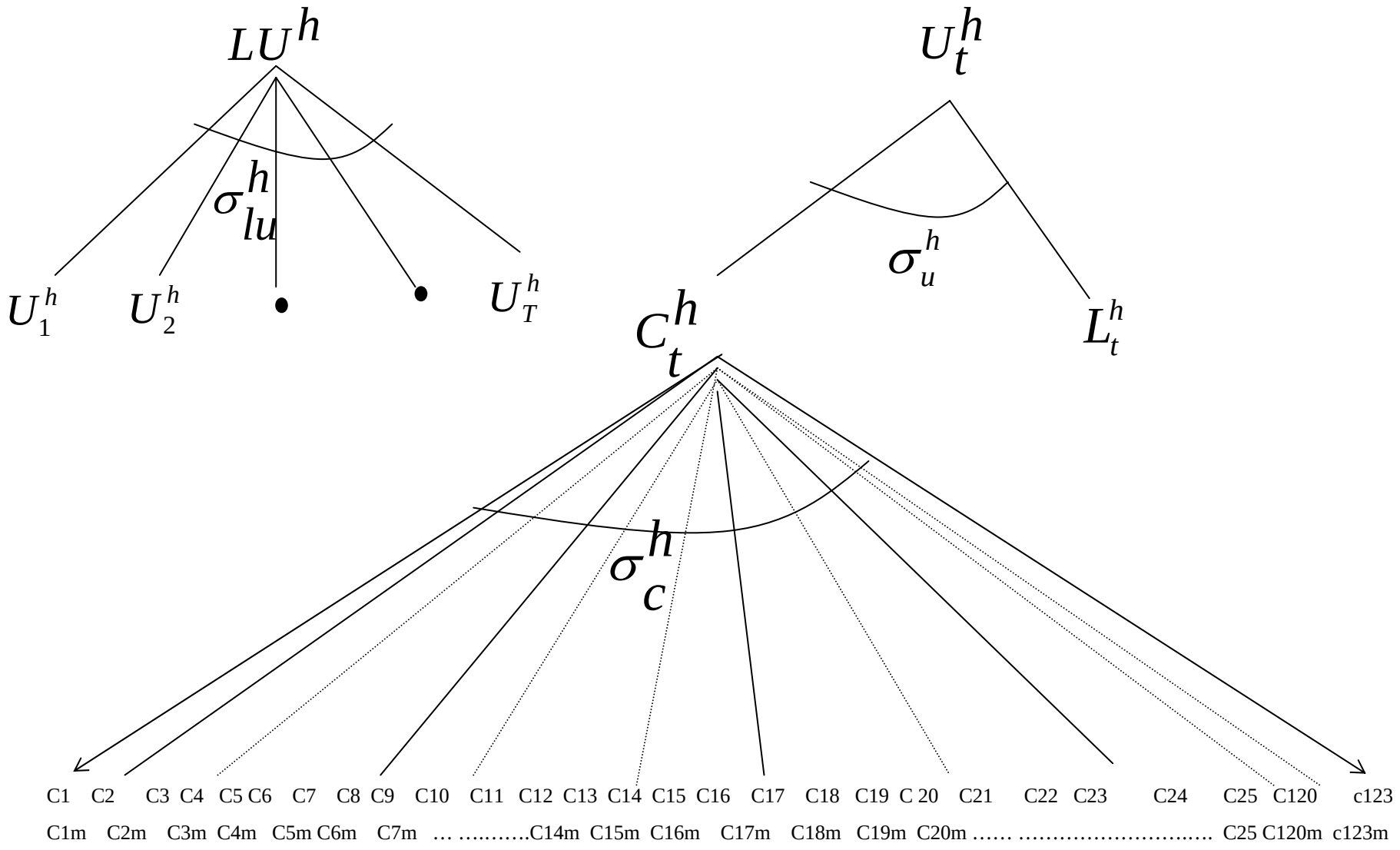
- Production
  - Capital
  - Labour
  - Technology
  - Input-output structure

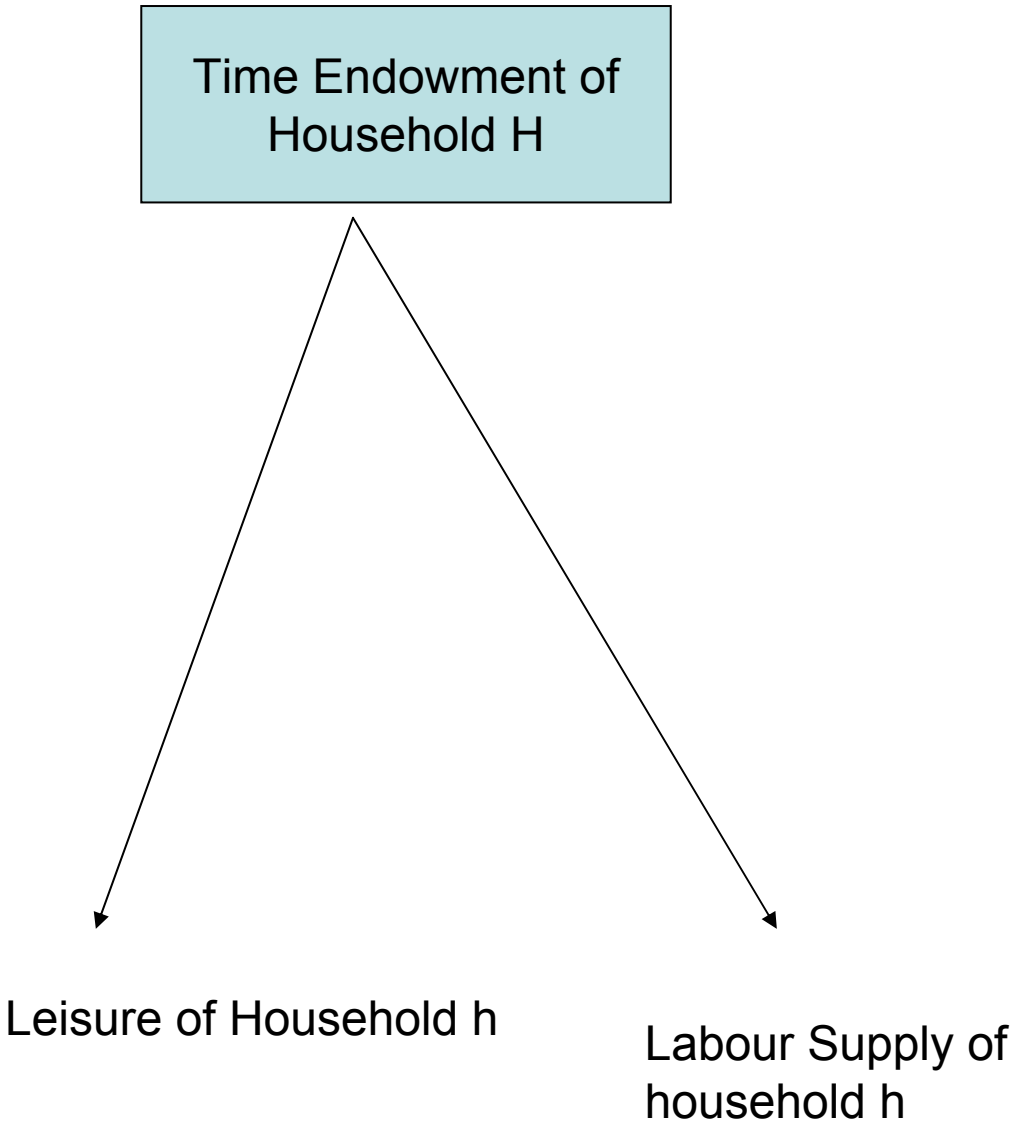
Nested functions

Price based substitutions

Separate models with nine, eleven, 16, 21 and 123 sectors

# Lifetime and Instantaneous Utility Function of a Household in the BHI CGE Model




Time Endowment of Household H
Leisure of Household h
Labour Supply of household h

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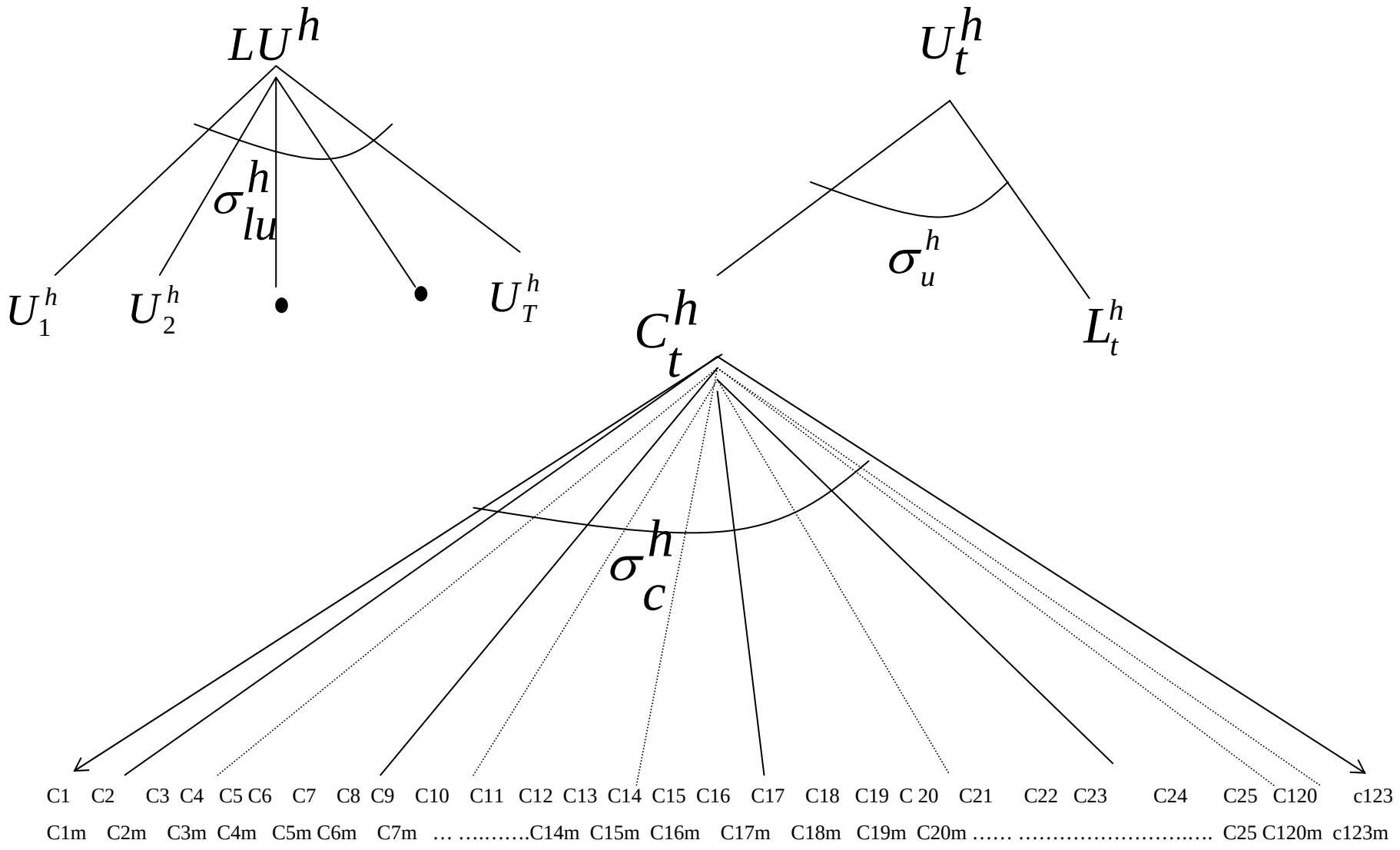

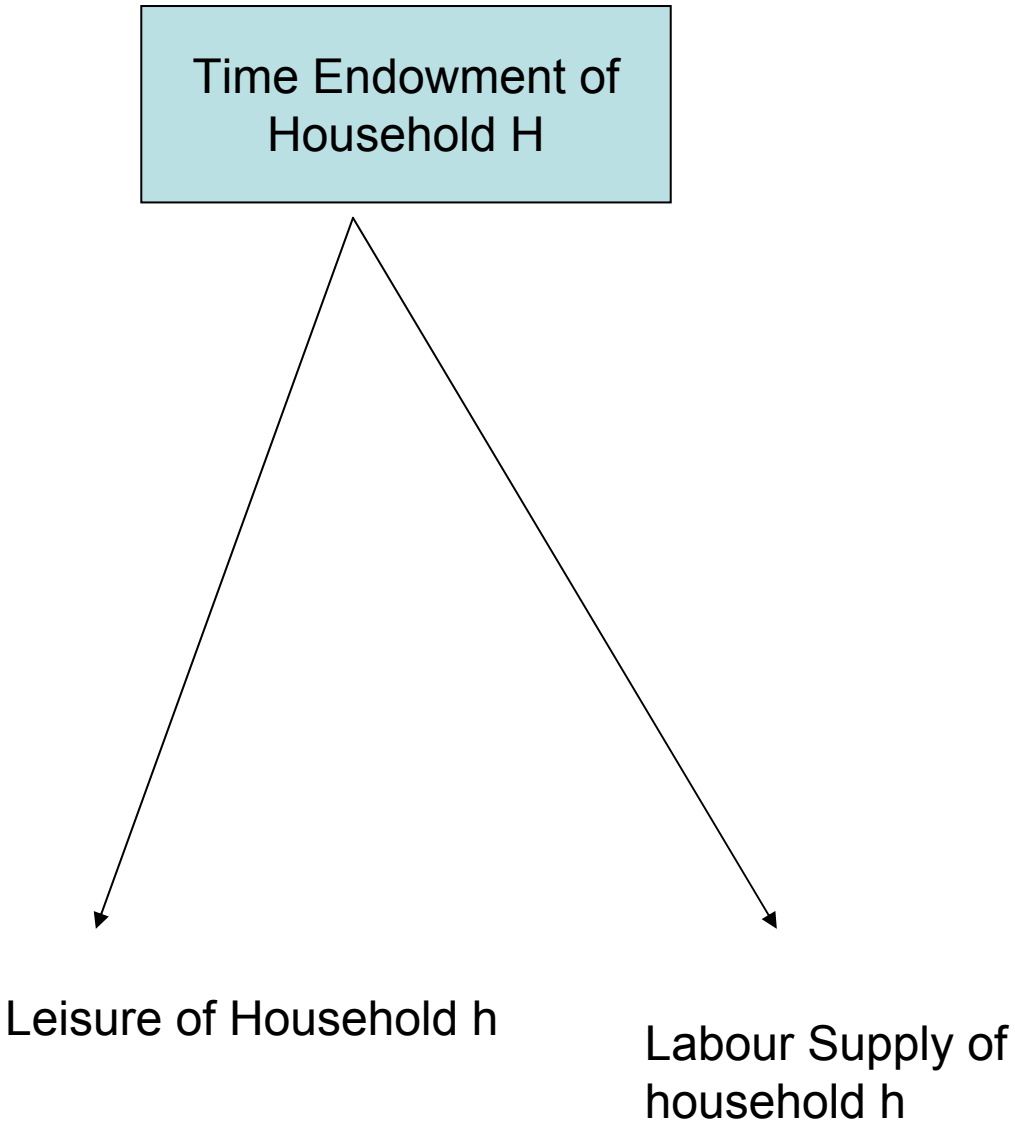
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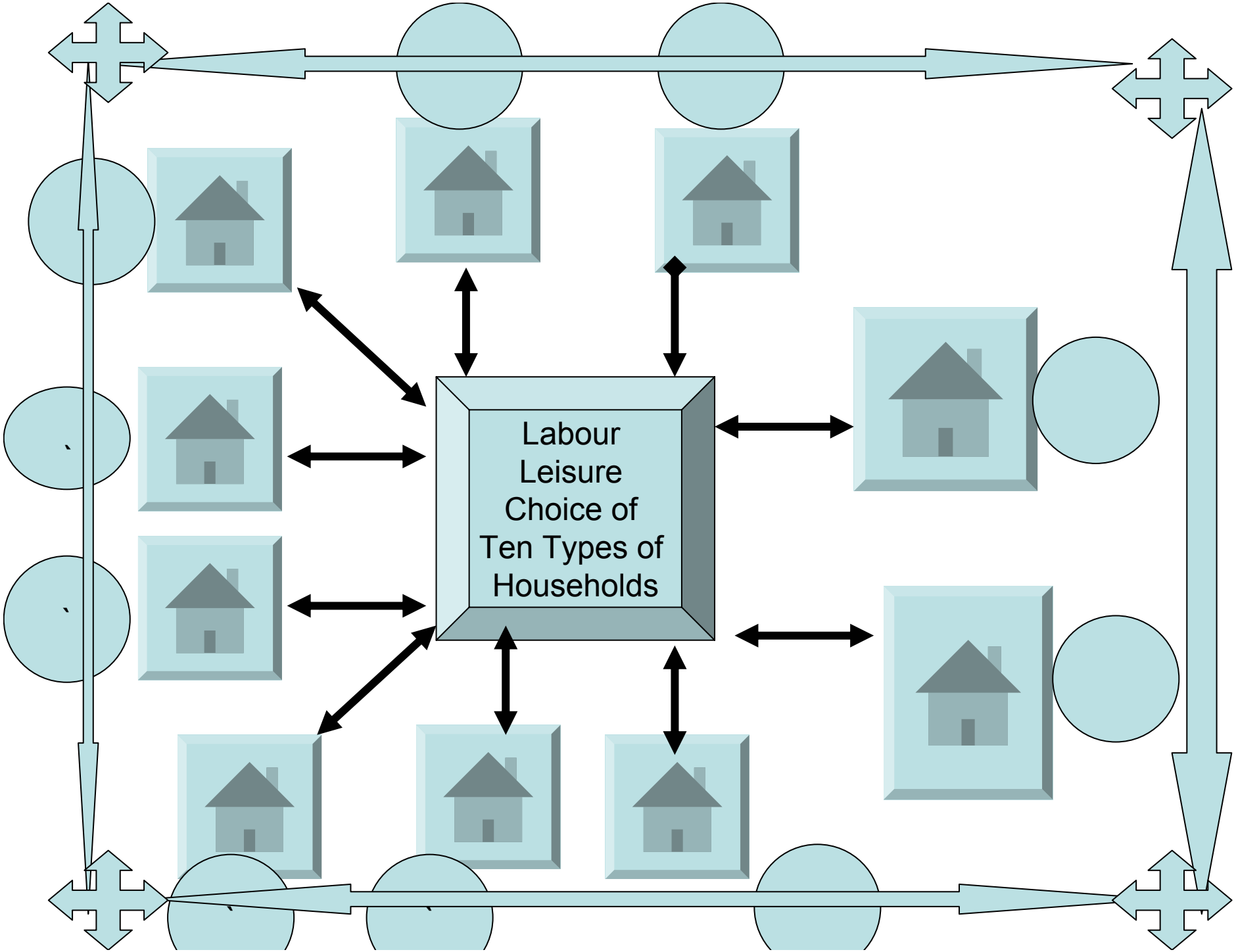
Labour
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Choice of
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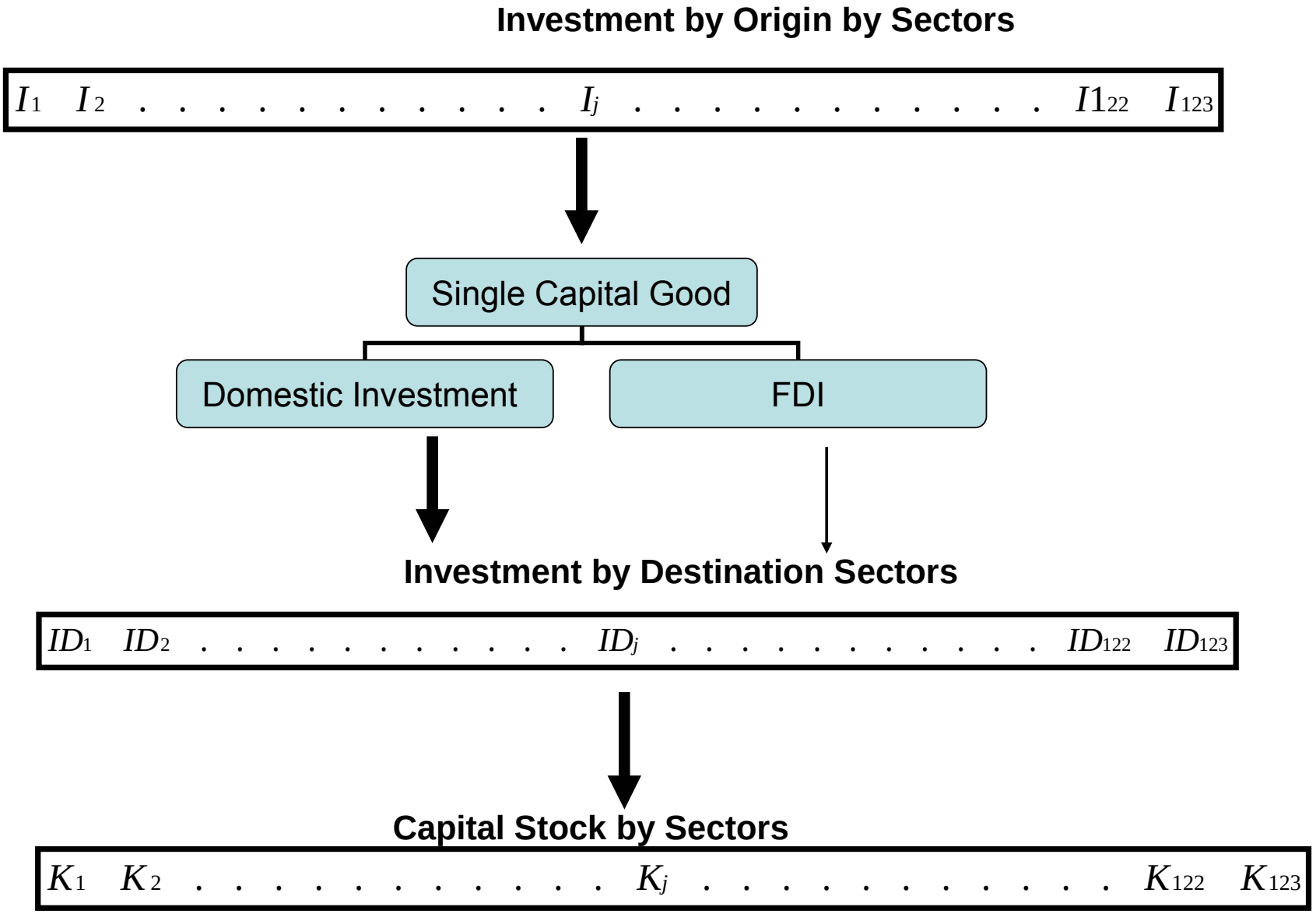
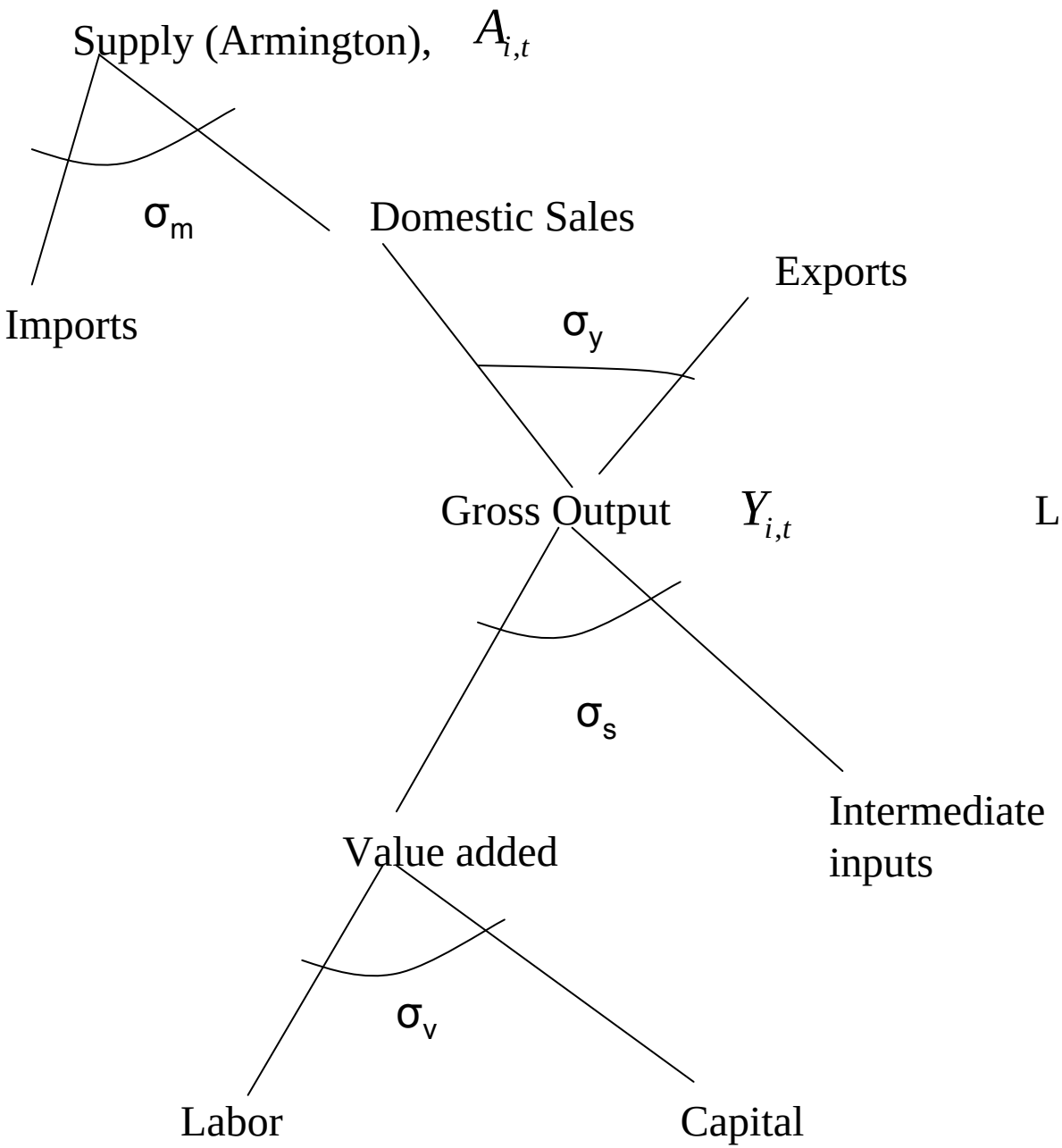

Investment by Origin by Sectors
$I_1$ $I_2$ . . . . . $I_j$ . . . . . $I122$ $I_{123}$
Single Capital Good
Domestic Investment
FDI
Investment by Destination Sectors
$ID_1$ $ID_2$ . . . . . $ID_j$ . . . . . $ID_{122}$ $ID_{123}$
Capital Stock by Sectors
$K_1$ $K_2$ . . . . . $K_j$ . . . . . $K_{122}$ $K_{123}$




Dynamic Analysis

Law of capital accumulation

and

Investment by origin and destination

and

Steady state and Transitional dynamics

Production and Trade in the Economy

# Main Parts of an input-output Model of an Economy

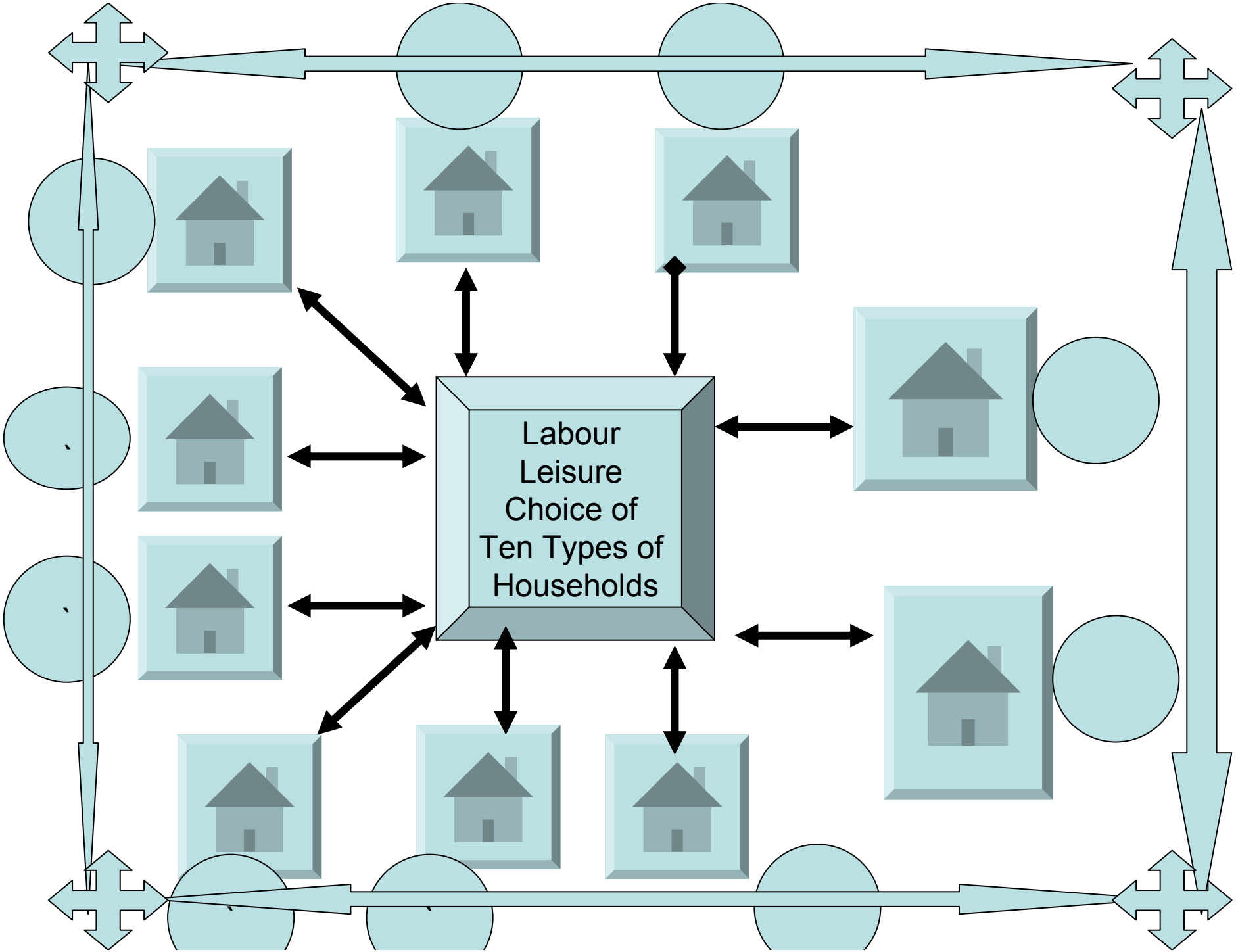
INTERMEDIATE INPUT
a(I,j) =input from sector i to sector j

FINAL DEMAND
Consumption
Investment
Government spending
Exports

PRIMARY INPUT

Primary imports
Value added:
Capital income
Labour income
Taxes

TRANSFERS
Transfers from govt to hh
Capital inflow: remittances


Labour
Leisure
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Ten Types of
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# Figure 4
# Backward and Forward Linkages across Industries

$$A = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix}$$

Input-Output Coefficients for the UK Economy: Thee sector aggregation

| | Manufacturing | Distribution | Services |
|---|---|---|---|
| Manufacturing | 0.327263 | 0.123182 | 0.074824 |
| Distribution | 0.044565 | 0.031169 | 0.016667 |
| Services | 0.119756 | 0.264192 | 0.286766 |

Basic Parameters of the nine sector model

| | |
|---|---|
| Intertemporal elasticity of substation between consumption and leisure | 1.15 |
| Elasticity of substitution between capital and labour | 1.5 |
| Growth rate of output in the benchmark across sectors | 0.03 |
| Benchmark rate of interest | 0.05 |
| Rate of depreciation of the capital stock across sectors | 0.02 |
| Rate of intertemporal substitution | 0.95 |

| | H1 | H2 | h3 | h4 | h5 | h6 | h7 | h8 | h9 | h10 |
|---|---|---|---|---|---|---|---|---|---|---|
| wage | 3436 | 9935 | 18974 | 29170 | 37692 | 47379 | 54874 | 61726 | 72055 | 97817 |
| intr | 2682 | 1370 | 4257 | 6006 | 9155 | 12975 | 17115 | 15599 | 21022 | 105197 |
| Leisure | 2577 | 7451 | 14230 | 21877 | 28269 | 35535 | 41156 | 46294 | 54041 | 73363 |
| HH Inc Tax | 0 | 0.05 | 0.1 | 0.15 | 0.2 | 0.25 | 0.3 | 0.35 | 0.4 | 0.45 |
| Cons share | 0.0177 | 0.0255 | 0.041 | 0.0573 | 0.0737 | 0.0935 | 0.1108 | 0.1175 | 0.1412 | 0.3219 |
| Transfer | 1520 | 1913 | 4291 | 6388 | 8796 | 11628 | 14279 | 14641 | 18185 | 54500 |
| Ini. Consmp. | 5671 | 12497 | 24869 | 37904 | 49829 | 63532 | 74858 | 81973 | 97409 | 179081 |

Endowment of labour and capital of households

Source: Department of work and Pension, 2005.

# Sectoral parameters

| | Capital tax | Labour tax | Depreciation | Growth rate | Pollution Coefficient | Counter fact L-tax | Counter Fact Ktax |
|---|---|---|---|---|---|---|---|
| Agric | -0.0011 | -0.0021 | 0.02 | 0.03 | 0.01 | 0.25 | 0.05 |
| Min | 0.0018 | 0.0188 | 0.02 | 0.03 | 0.01 | 0.25 | 0.05 |
| Manu | 0.0106 | 0.014 | 0.02 | 0.03 | 0.01 | 0.25 | 0.05 |
| Energy | 0.0388 | 0.1934 | 0.02 | 0.03 | 0.01 | 0.25 | 0.05 |
| Const | 0.0269 | 0.0041 | 0.02 | 0.03 | 0.01 | 0.25 | 0.05 |
| Distb | 0.0079 | 0.0107 | 0.02 | 0.03 | 0.01 | 0.25 | 0.05 |
| Trans | 0.0303 | 0.0398 | 0.02 | 0.03 | 0.01 | 0.25 | 0.05 |
| Busi | 0.0121 | 0.0404 | 0.02 | 0.03 | 0.01 | 0.25 | 0.05 |
| othSect | 0.0426 | 0.0078 | 0.02 | 0.03 | 0.01 | 0.25 | 0.05 |

Source: Derived from the input output table

## Endowment of labour and capital of households

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Source: Department of work and Pension, 2005.

Figure 8: Level of pollution in the benchmark and counterfactual scenario

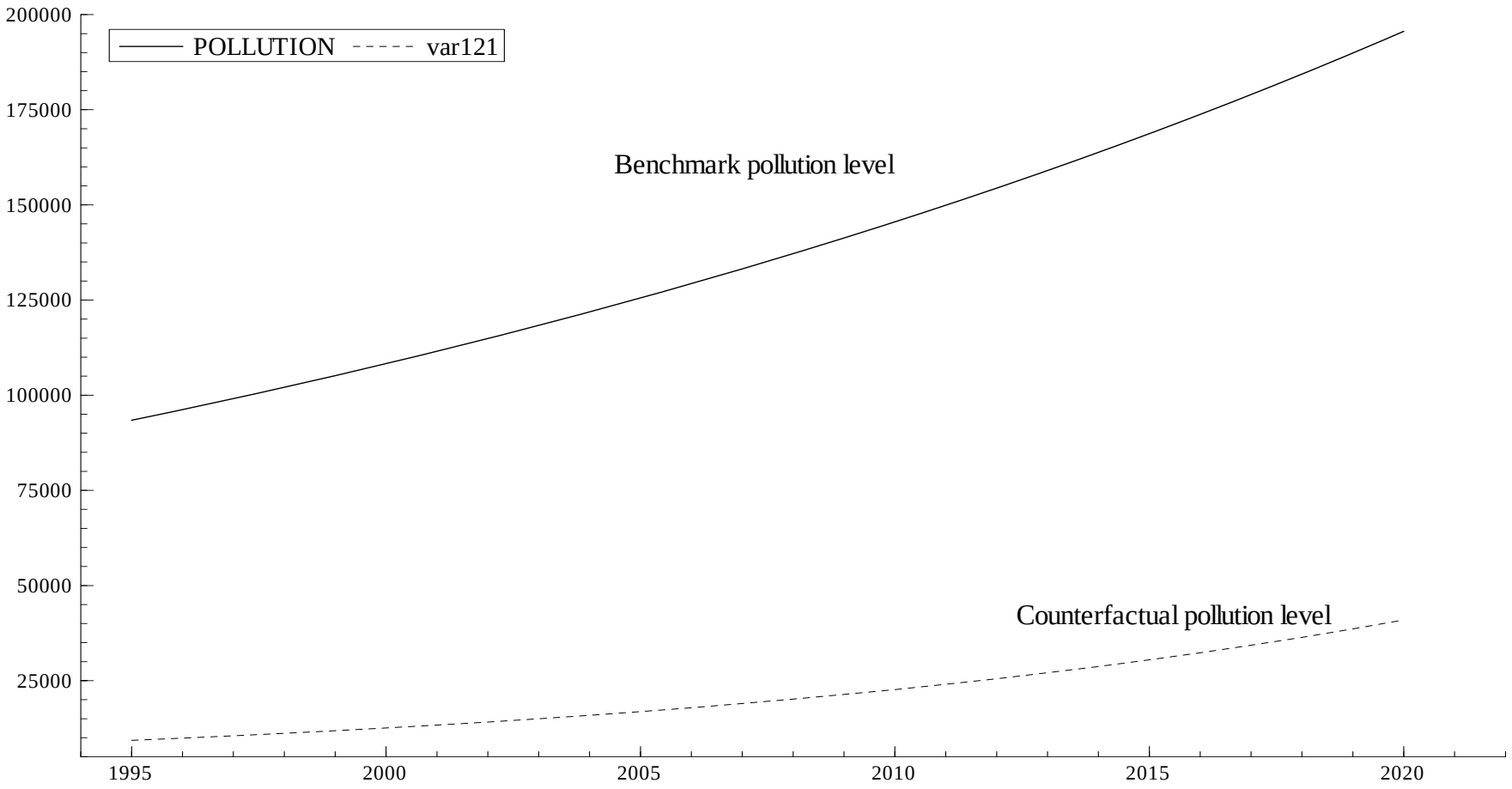
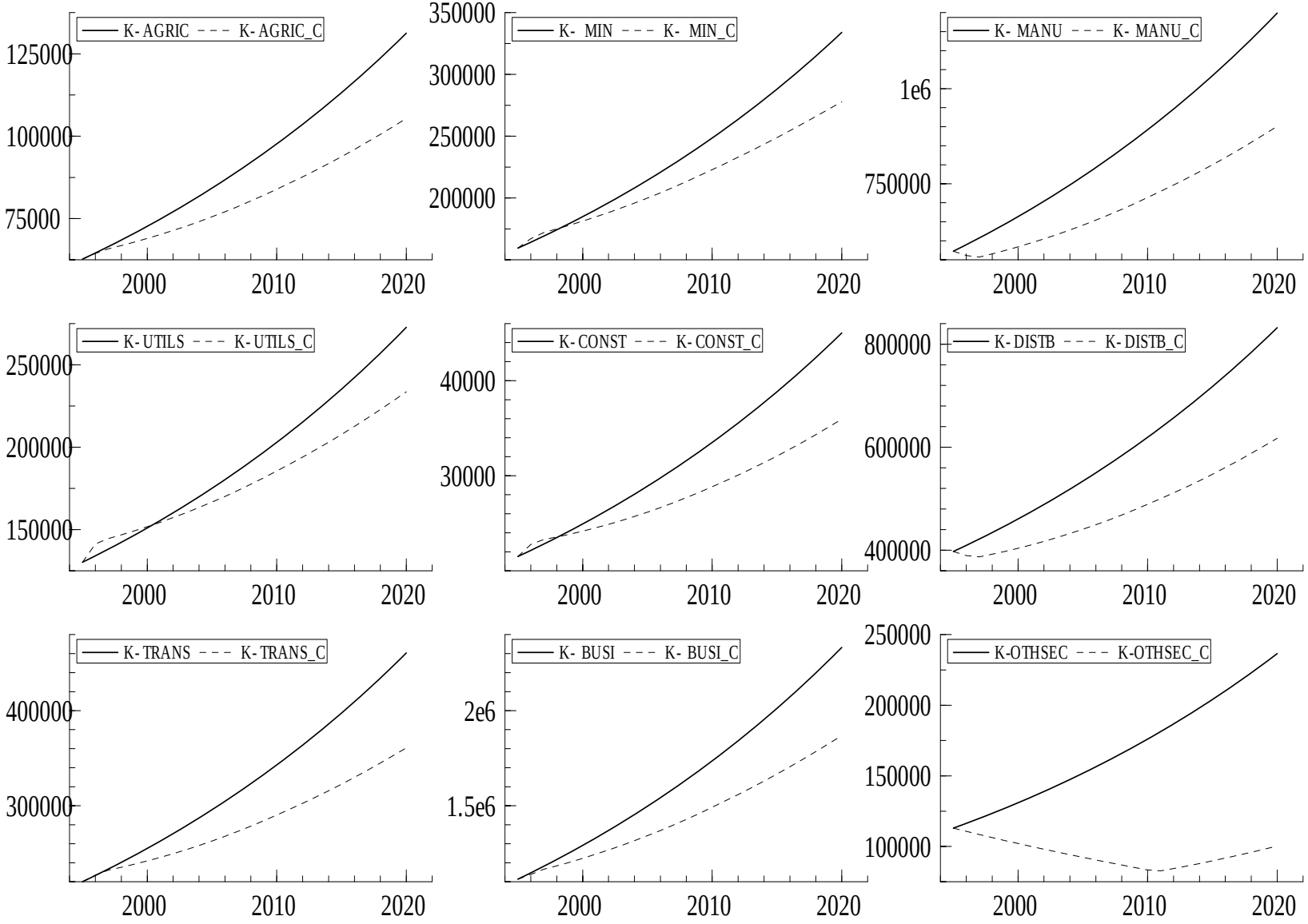


Figure 4: Impact of carbon energy taxes in capital stock by sectors



# Figure 5: Macroeconomic impacts of carbon energy taxes

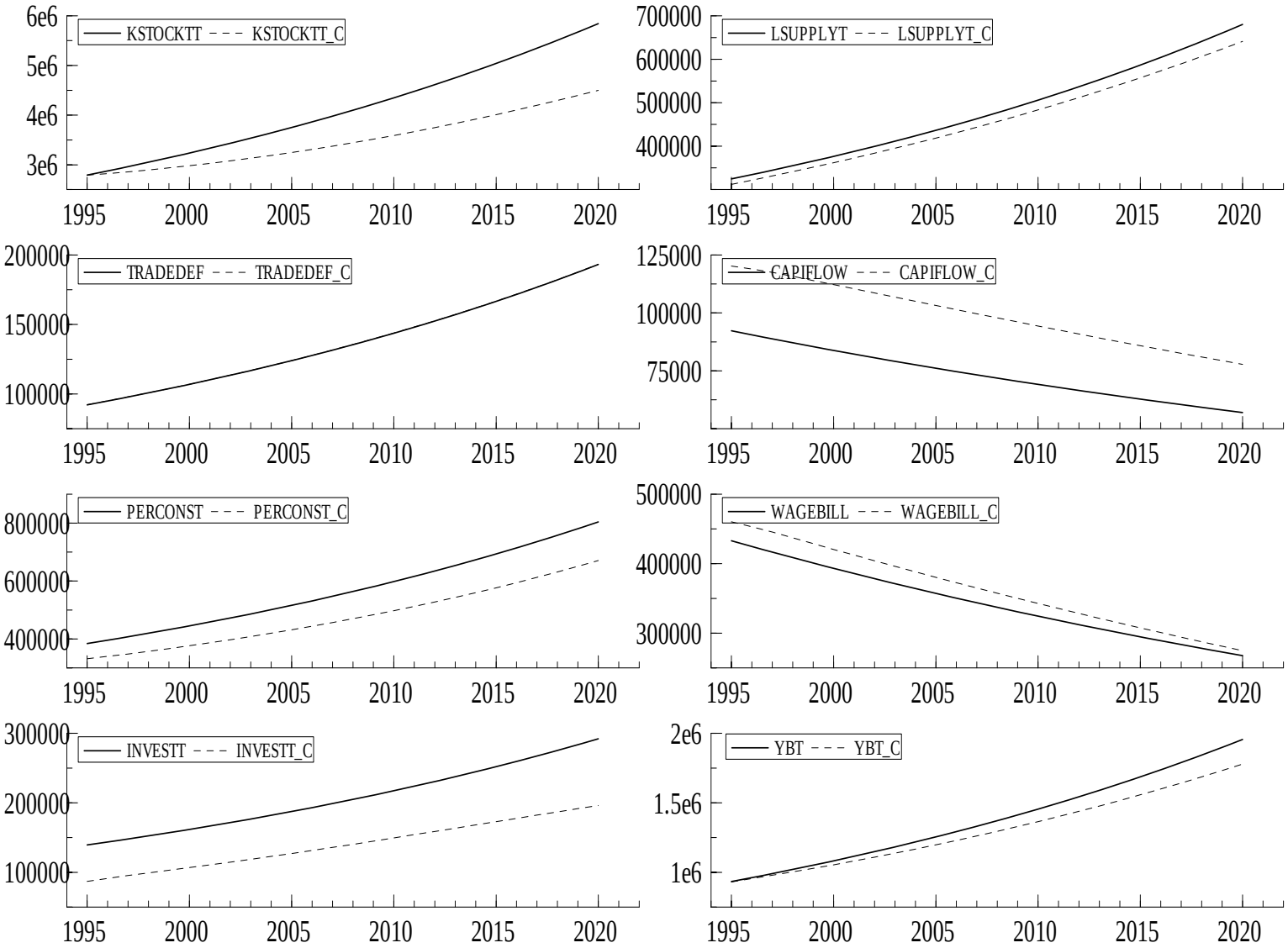
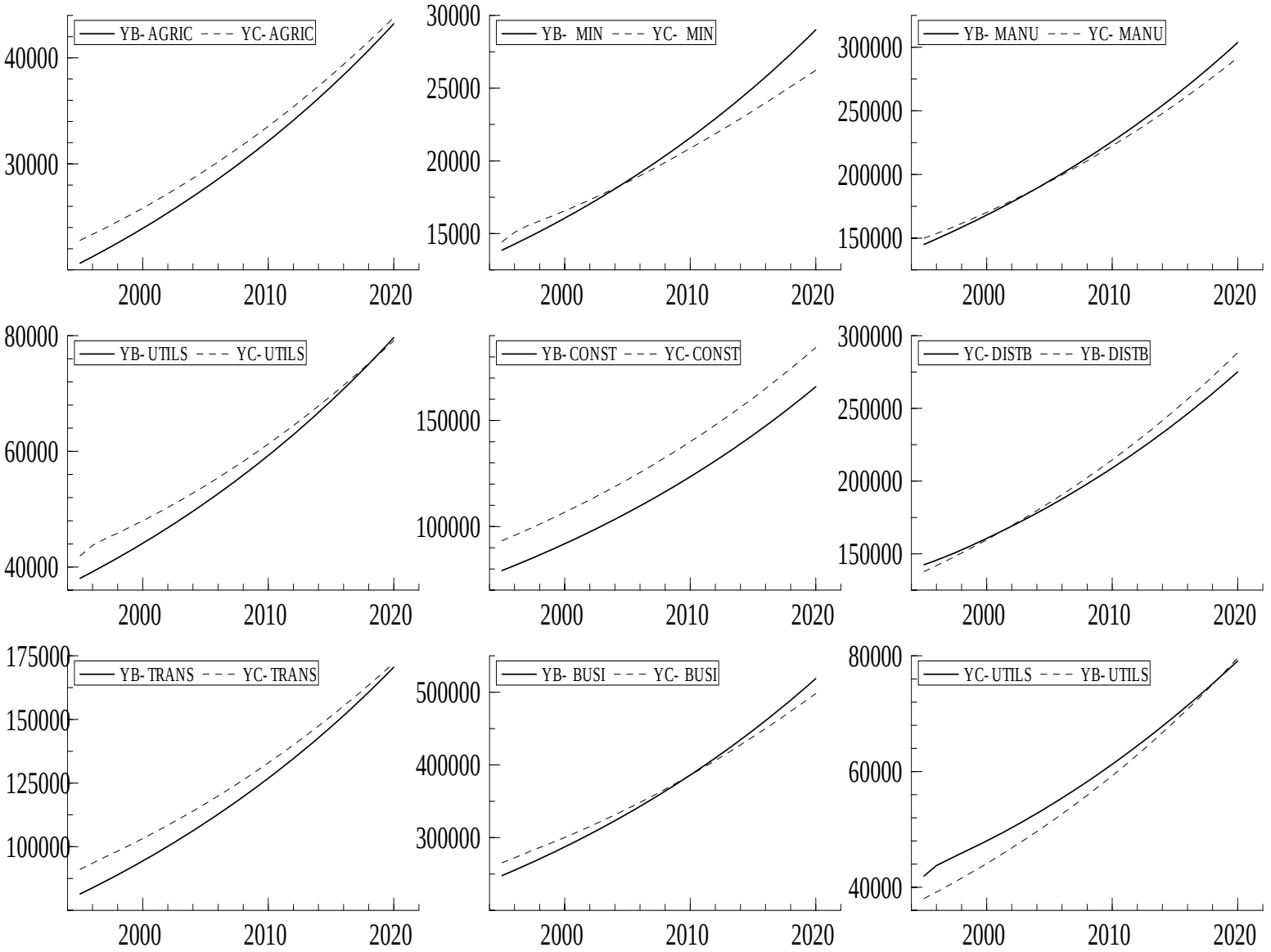


Figure 6: Impact of carbon energy taxes in the levels of output by sectors



# Figure 7: Impact of energy carbon taxes on employment by sectors

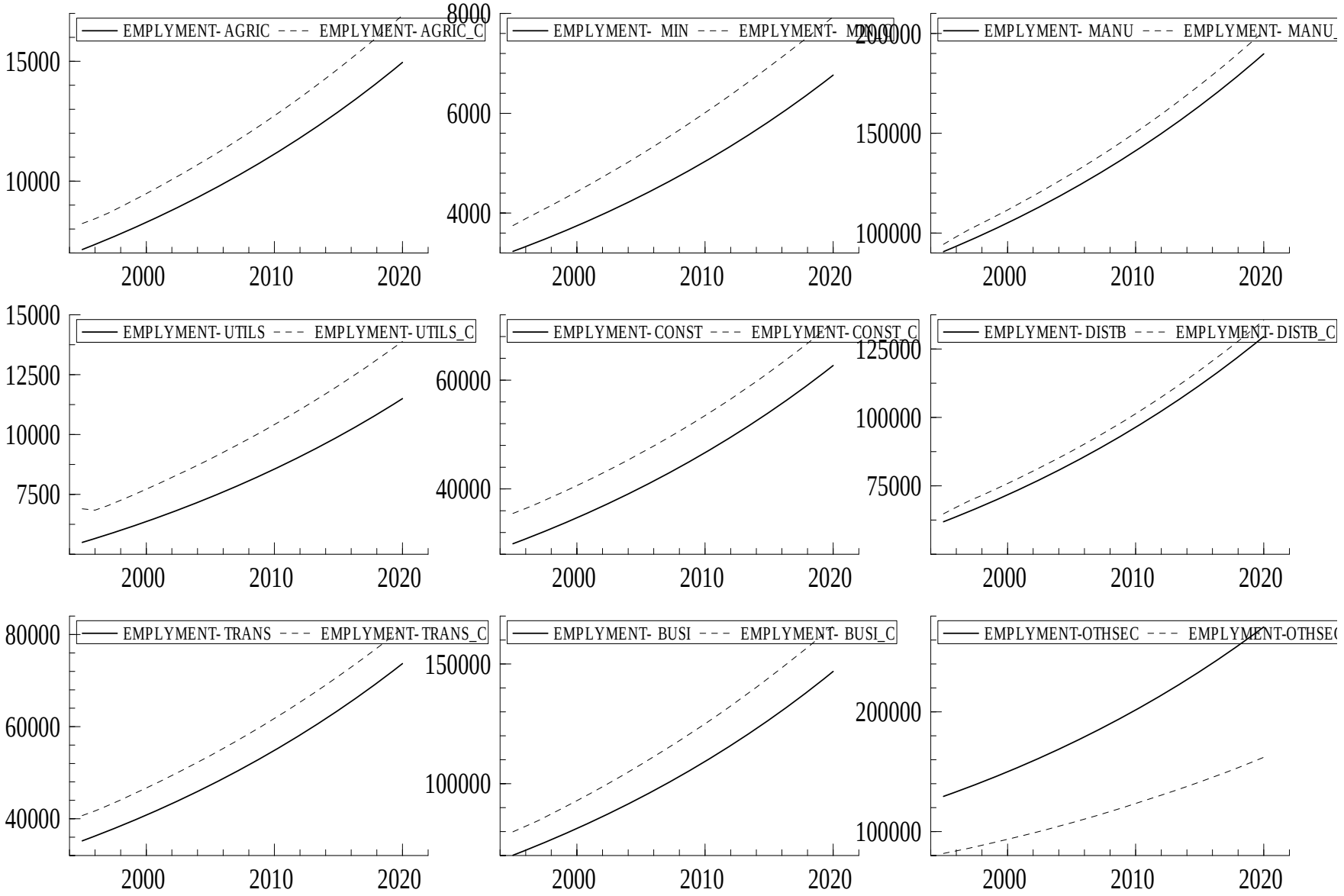


Figure 7: Impact of energy carbon taxes on investment by sectors

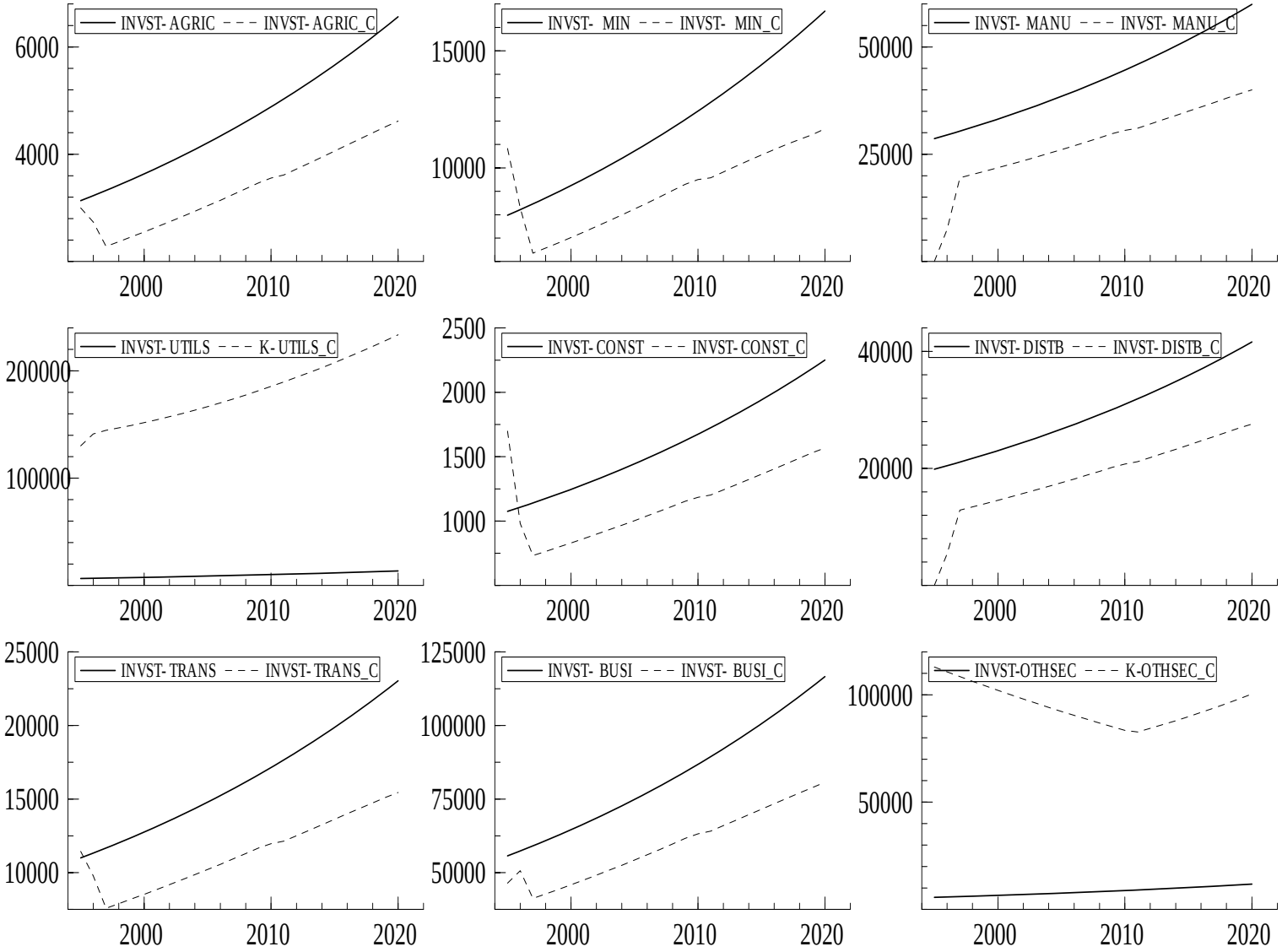


Figure 9a: Impact of carbon energy taxes in utility level of households

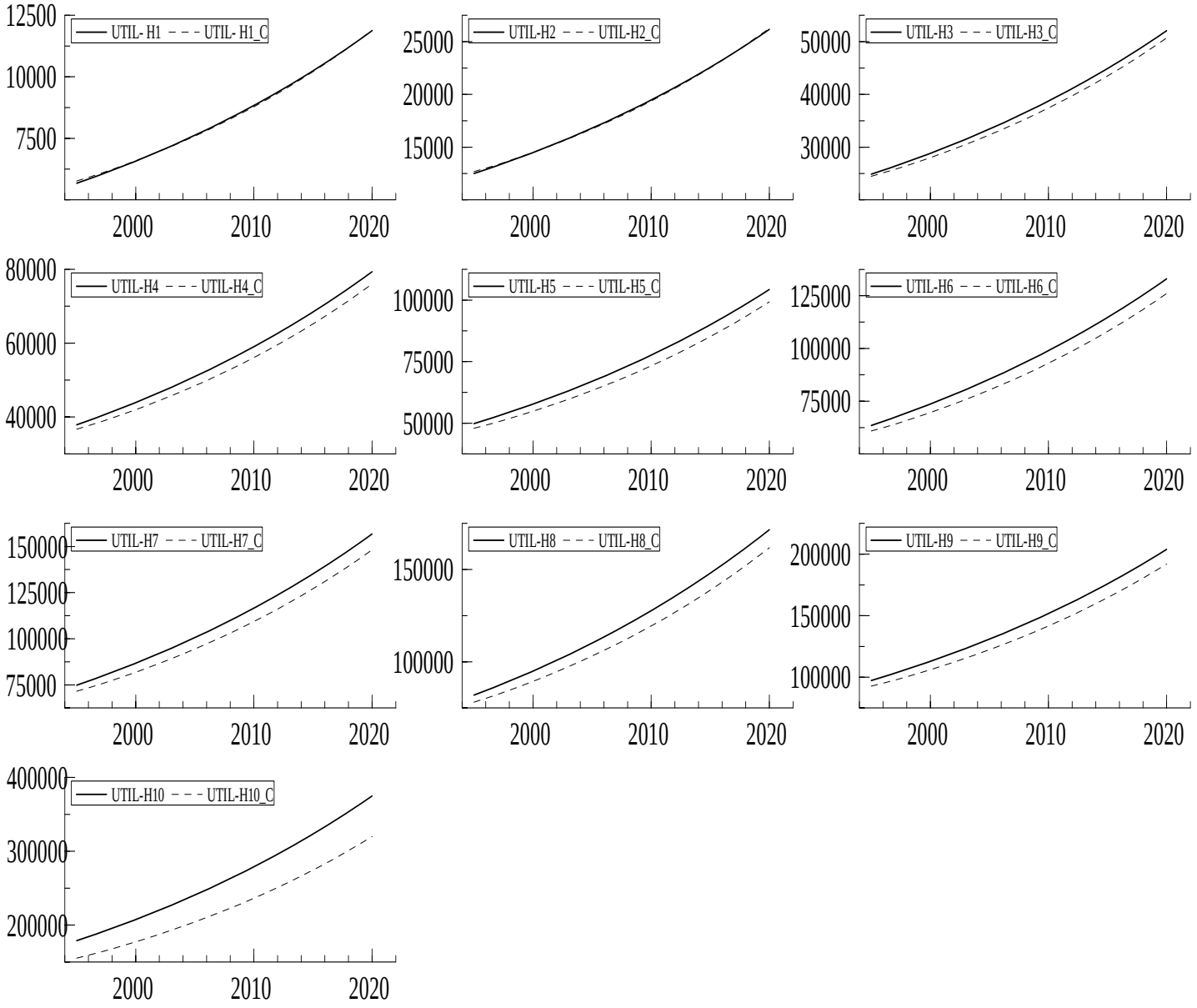


Figure 10b: Comparing Utility Level All Households in Counterfactual Scenario

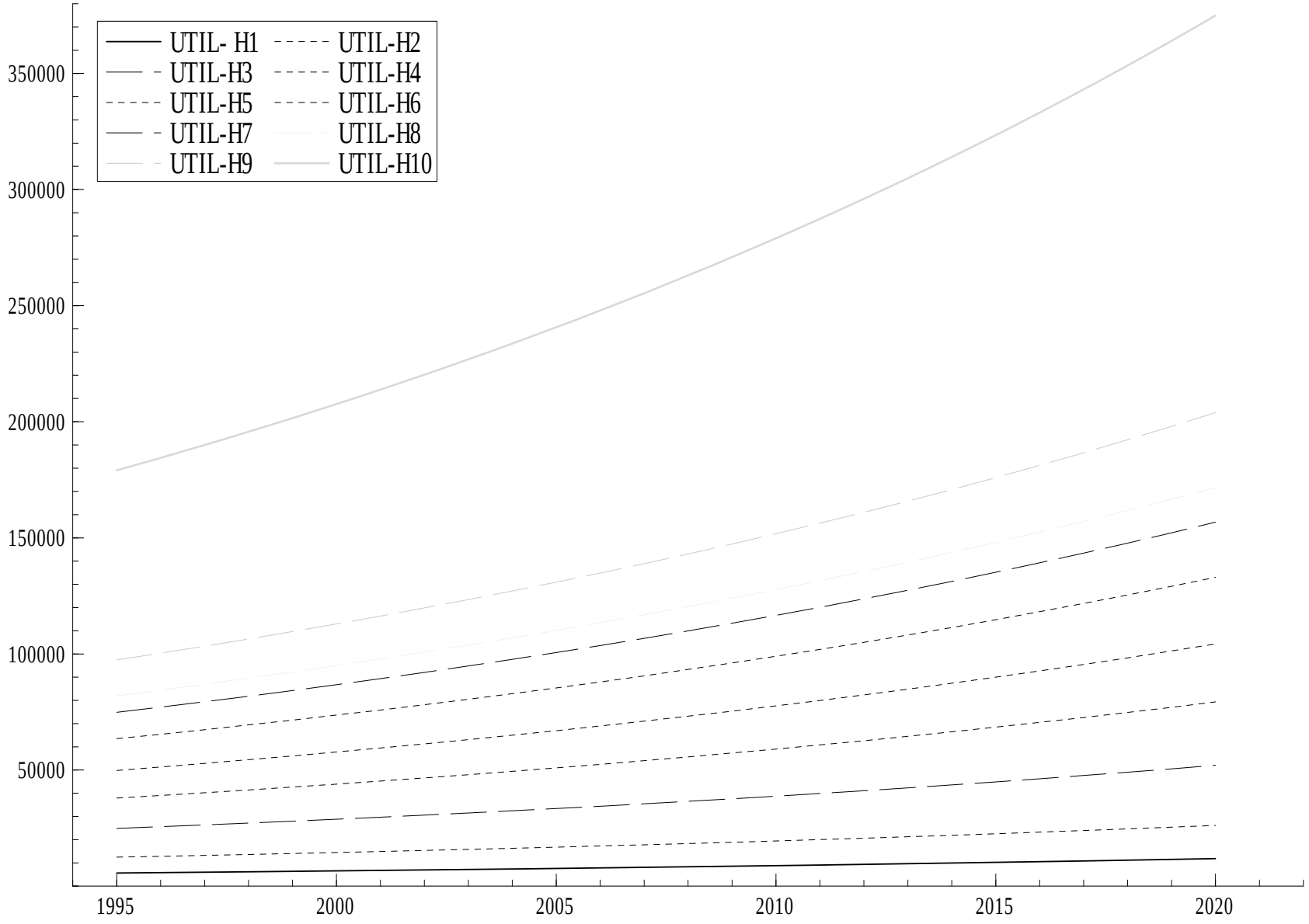


Figure 11: Growth rate of output, investment and capital stock in agriculture.

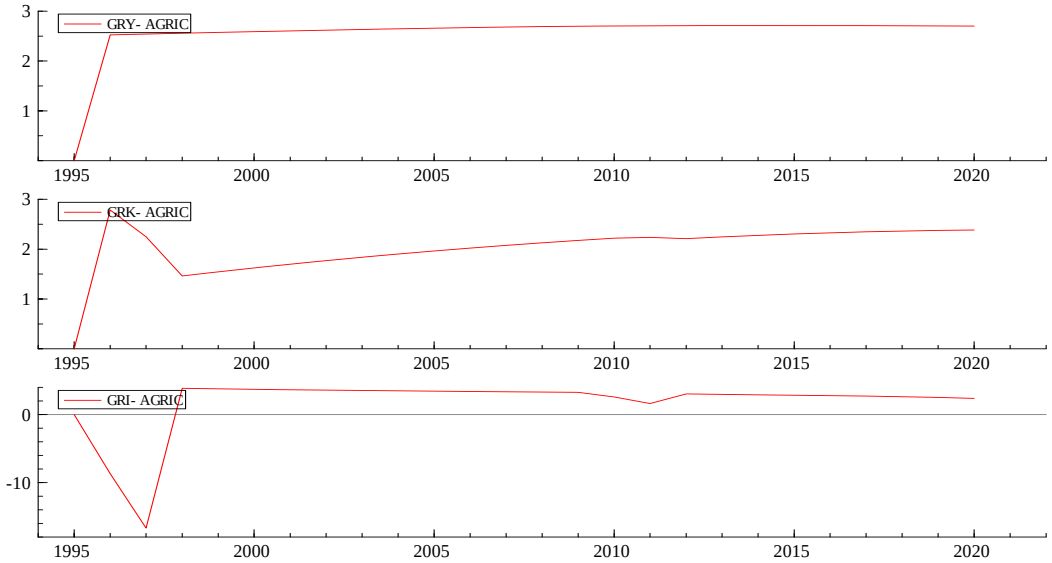



Figure 12: Growth rate of output, investment and capital stock in mining

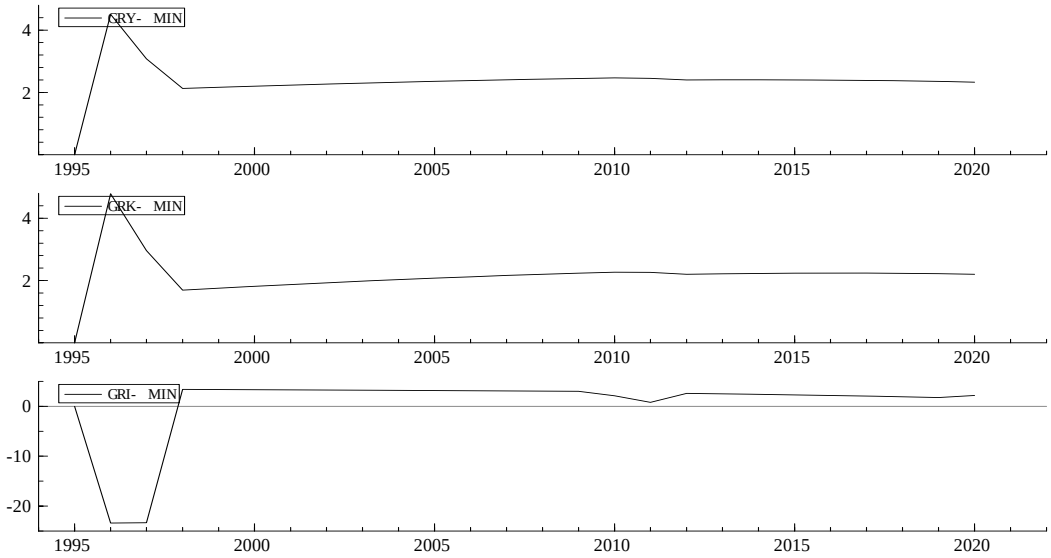


Figure 13: Growth rate of output, investment and capital stock in manufacturing sector

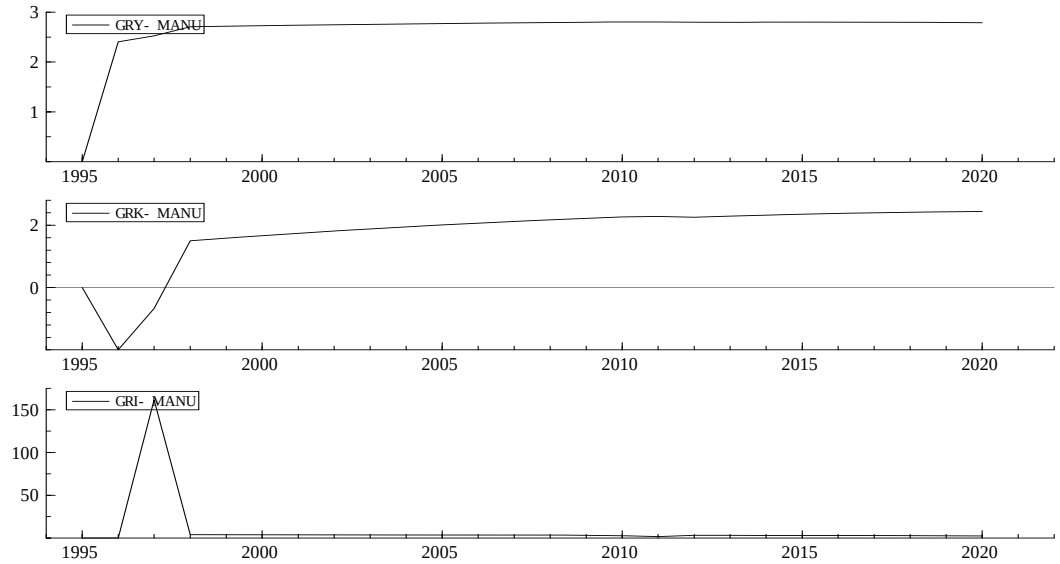



Figure 14: Growth rate of output, investment and capital stock in energy sector

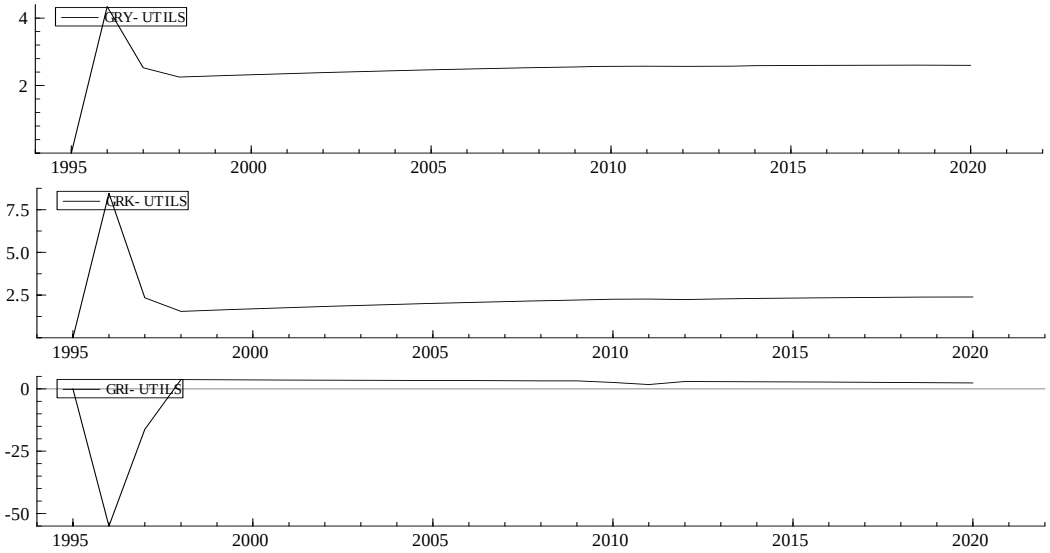


Figure 15: Growth rate of output, investment and capital stock in construction sector

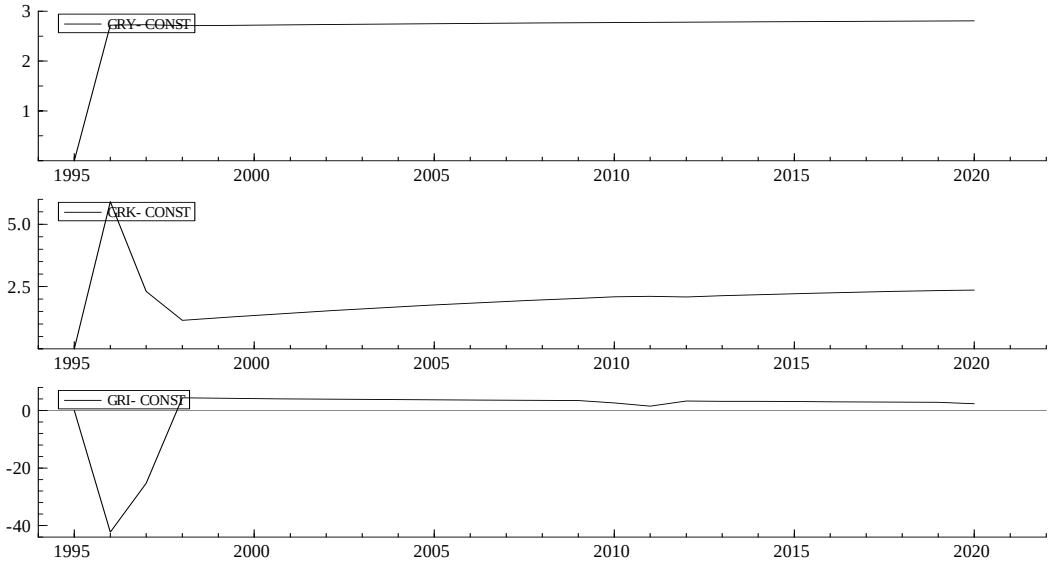



Figure 16: Growth rate of output, investment and capital stock in distribution sector

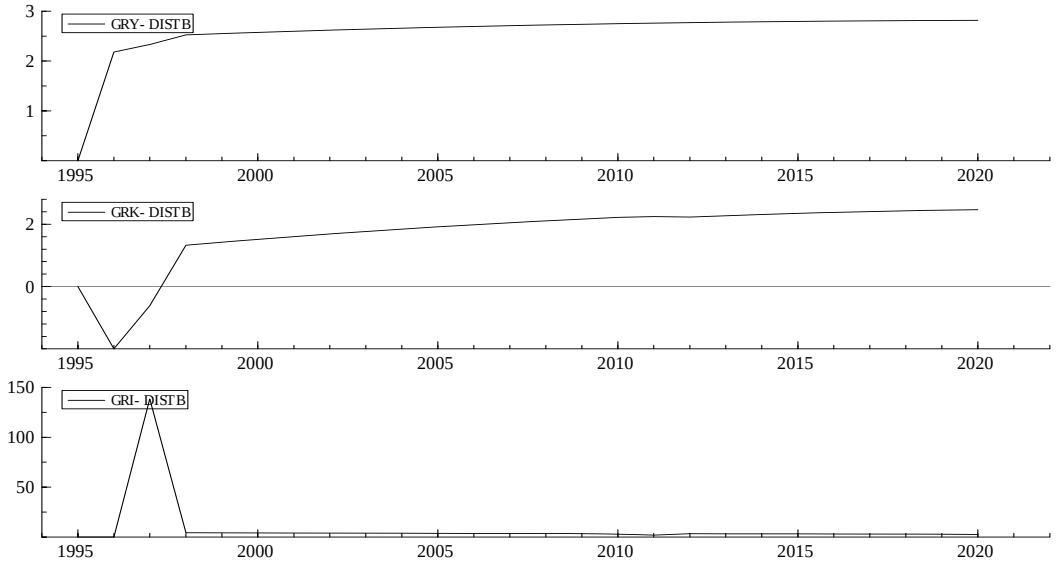


Figure 17: Growth rate of output, investment and capital stock in transport and communica

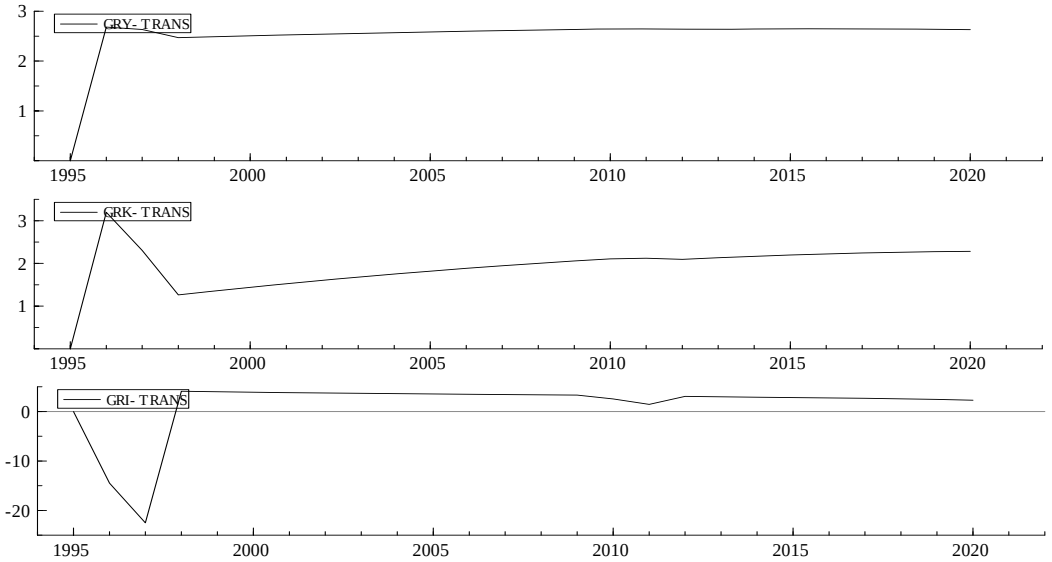



Figure 18: Growth rate of output, investment and capital stock in business sector

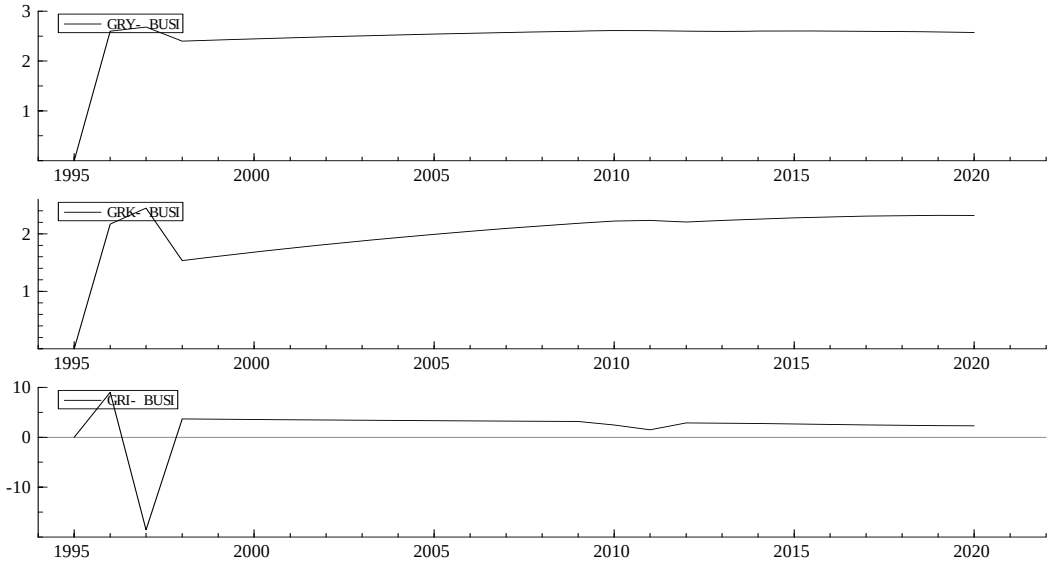
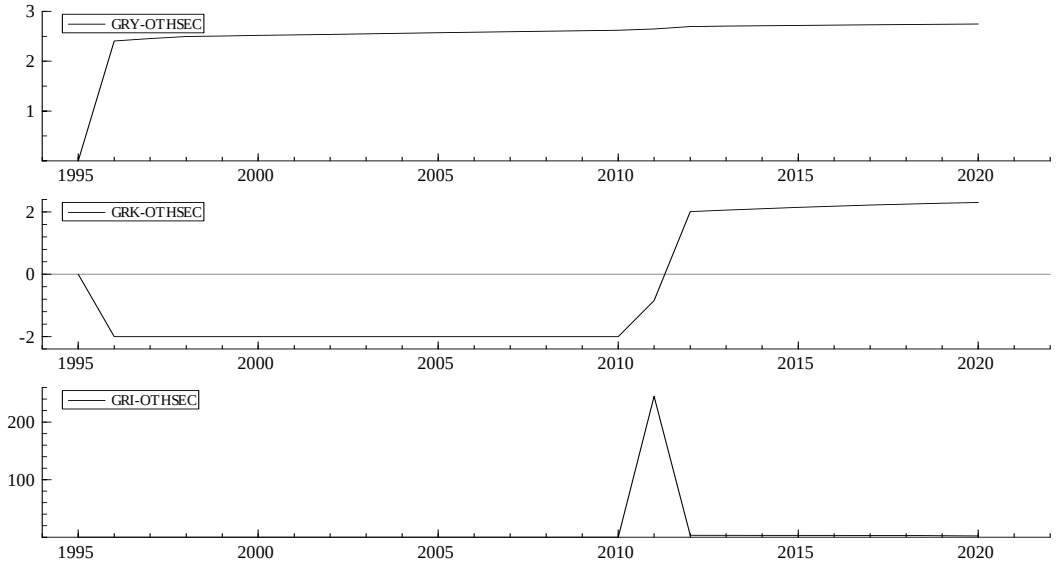


Figure 19: Growth rate of output, investment and capital stock in other sectors



# Conclusion of GEMEETUK Experiments

- evaluate the economy wide impacts of changes in pollution taxes imposed on use of capital and labour inputs in the capital accumulation, growth and allocation of resources across sectors in the UK economy benchmarking the model to ten households and 123 sectors
- Environment and energy taxes can slow down the rate of accumulation and growth and can make households worse off than when current policies remain as usual.
- Model results also show the structure of redistribution of income and the role of tax and transfer in explaining income and consumption inequalities of households over year.
- Policies that promote saving and investment can contribute towards long run growth.