Sectoral Business Cycles, Price Stabilization, and Climate Change Mitigation

Stabilizing Unstable Economy-Ecology Interactions

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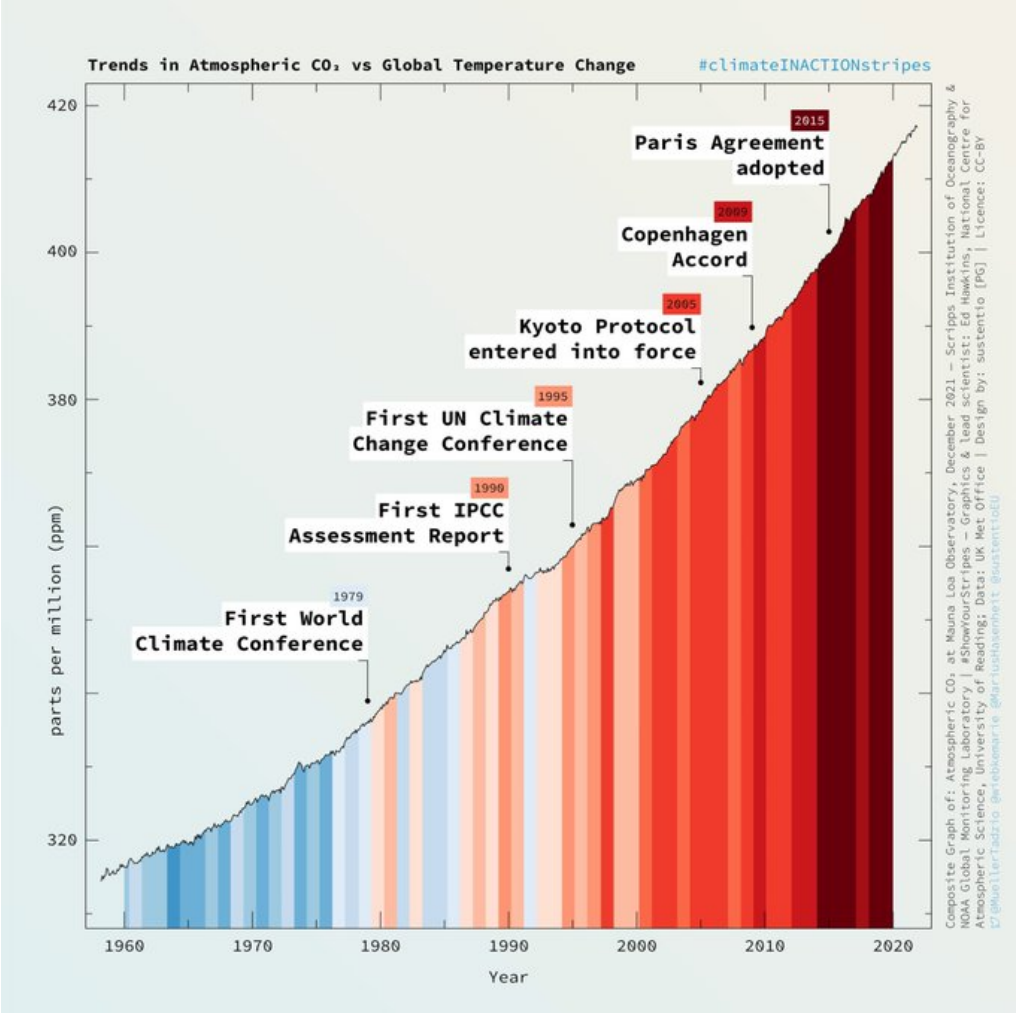
Motivation: Do Climate Accords Drive Carbon Emissions?



Introduction

- In the face of the dual inflationary threats of de-globalization and climate change, policy-makers are currently embracing more activist policies of price stabilization such as strategic price controls (such as on European energy) or tax-subsidy schemes (such as the US Inflation Reduction Act).
- The microeconomic literature on the stability of competitive economies is re-purposed to develop a data-driven dynamic model of ecologically-extended multi-sector growth.
- Sector-oriented policies to accelerate the low-carbon transition while stabilizing prices are investigated.

Main Findings

1. A highly hierarchical economic structure of intermediate production is highly vulnerable to input cost shocks and climate disasters.
2. While price controls stabilize economic fluctuations, they fail to reduce environmental impact.
3. Tax-subsidy mixes reduce environmental impact, while stabilizing prices at the same time.

The Bielefeld Disequilibrium Approach

- **Cross-Dual Adjustment**
  - *Walrasian Law of Excess Demand*
    if demand d_i is above (below) supply x_i, price p_i rises (falls)
  - *Classical Law of Excess Profitability*
    if price p_i above (below) $cost_i$, quantity x_i rises (falls)
- **Keynesian Dual Adjustment**
  - *Oligopolistic Markup Pricing*
    if price p_i above (below) $cost_i$, price p_i falls (rises)
  - *Demand-led Inventory Adjustment*
    if demand d_i is above (below) supply x_i, quantity x_i rises (falls)

Out-of-Equilibrium Imbalances in Quantities and Prices

Supply-demand imbalance column-vector Δx is:

$$\Delta_x = \underbrace{Ax + gAx + c}_{\text{demand}} - \underbrace{x}_{\text{supply}} \equiv C(g) + c \qquad (1)$$

Unit profitability imbalance row-vector Δ_p is:

$$\Delta_p = \underbrace{pA + rpA + w}_{\text{unit cost}} - \underbrace{p}_{\text{unit revenue}} \equiv C(r) + w \qquad (2)$$

In equilibrium, supply equals demand:

$$\Delta_{x^*} = 0 \qquad \rightarrow \qquad x^* = [I - (1+g)A]^{-1}c = C^{-1}(g)c \qquad (3)$$

and profitability is uniform across sectors:

$$\Delta_{p^*} = 0 \qquad \rightarrow \qquad p^* = -w[I - (1+r)A]^{-1} = -C^{-1}(r)w \qquad (4)$$

The Composite Dynamical System

$$\dot{x} = \underbrace{\delta_{xx}\Delta_x}_{\text{Keynesian}} - \underbrace{\delta_{xp}\Delta_p^T}_{\text{classical}} \tag{5}$$

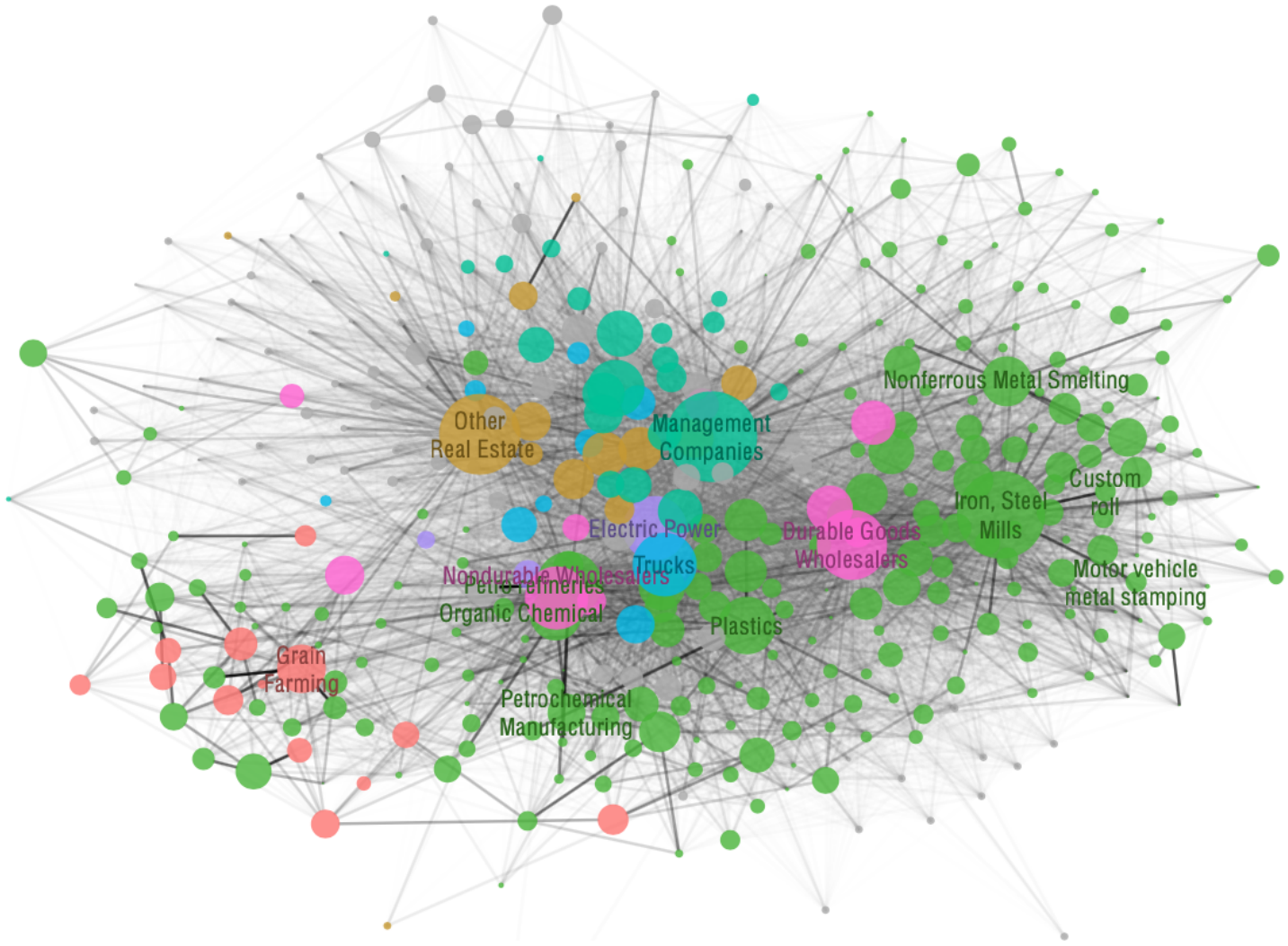
$$\dot{p}^T = \underbrace{\delta_{px}\Delta_x}_{\text{Walrasian}} + \underbrace{\delta_{pp}\Delta_p^T}_{\text{Keynesian}} \tag{6}$$

which can be simplified as:

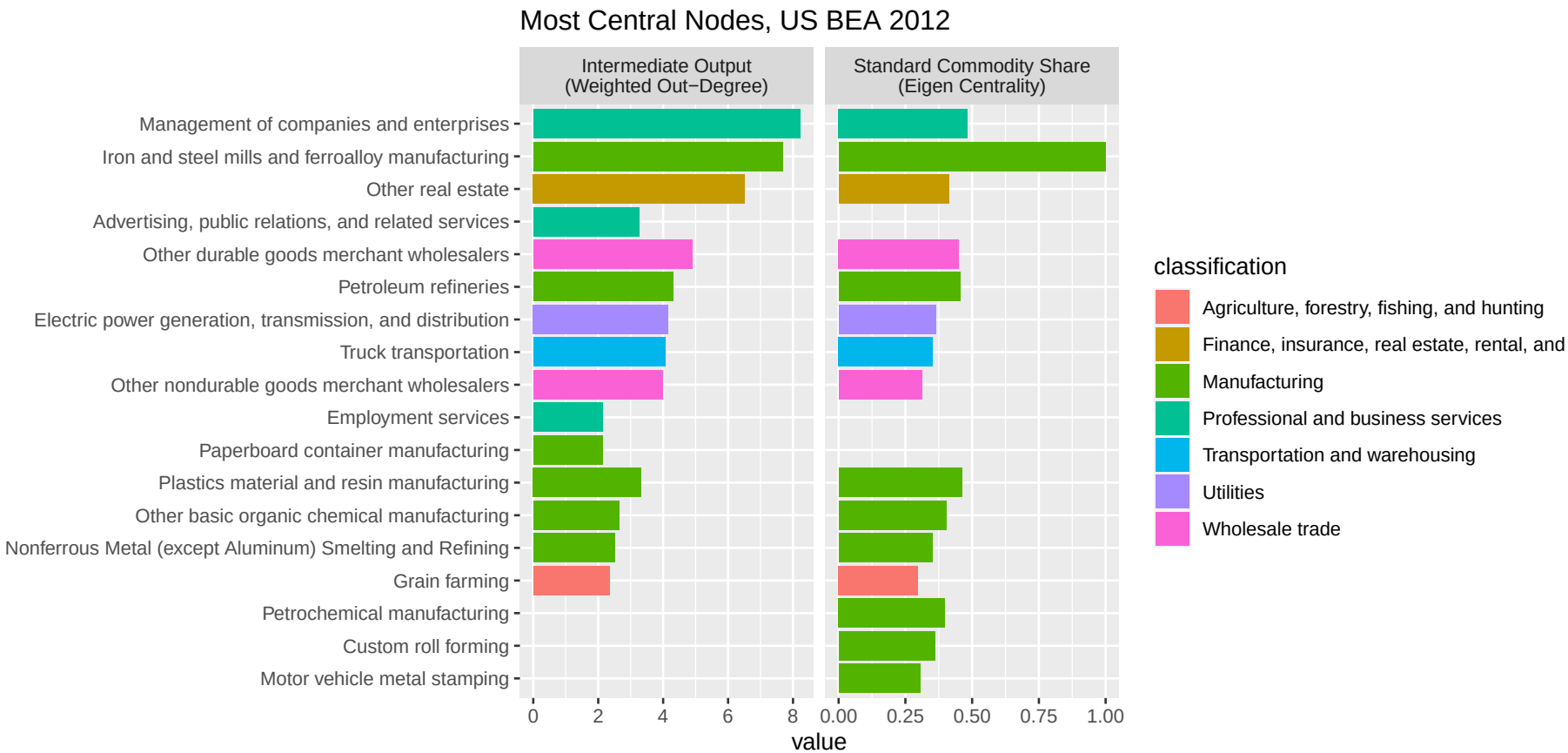
$$\begin{pmatrix} \dot{x} \\ \dot{p}^T \end{pmatrix} = \begin{pmatrix} \delta_{xx} & -\delta_{xp} \\ \delta_{px} & \delta_{pp} \end{pmatrix} \left\{ \begin{pmatrix} (1+g)A - I \\ [(1+r)A - I]^T \end{pmatrix} \begin{pmatrix} x \\ p^T \end{pmatrix} + \begin{pmatrix} c \\ w^T \end{pmatrix} \right\} \tag{7}$$

with homogeneous solution $y(t) = e^{Qt}y(0)$ where $y = z - z^*$.

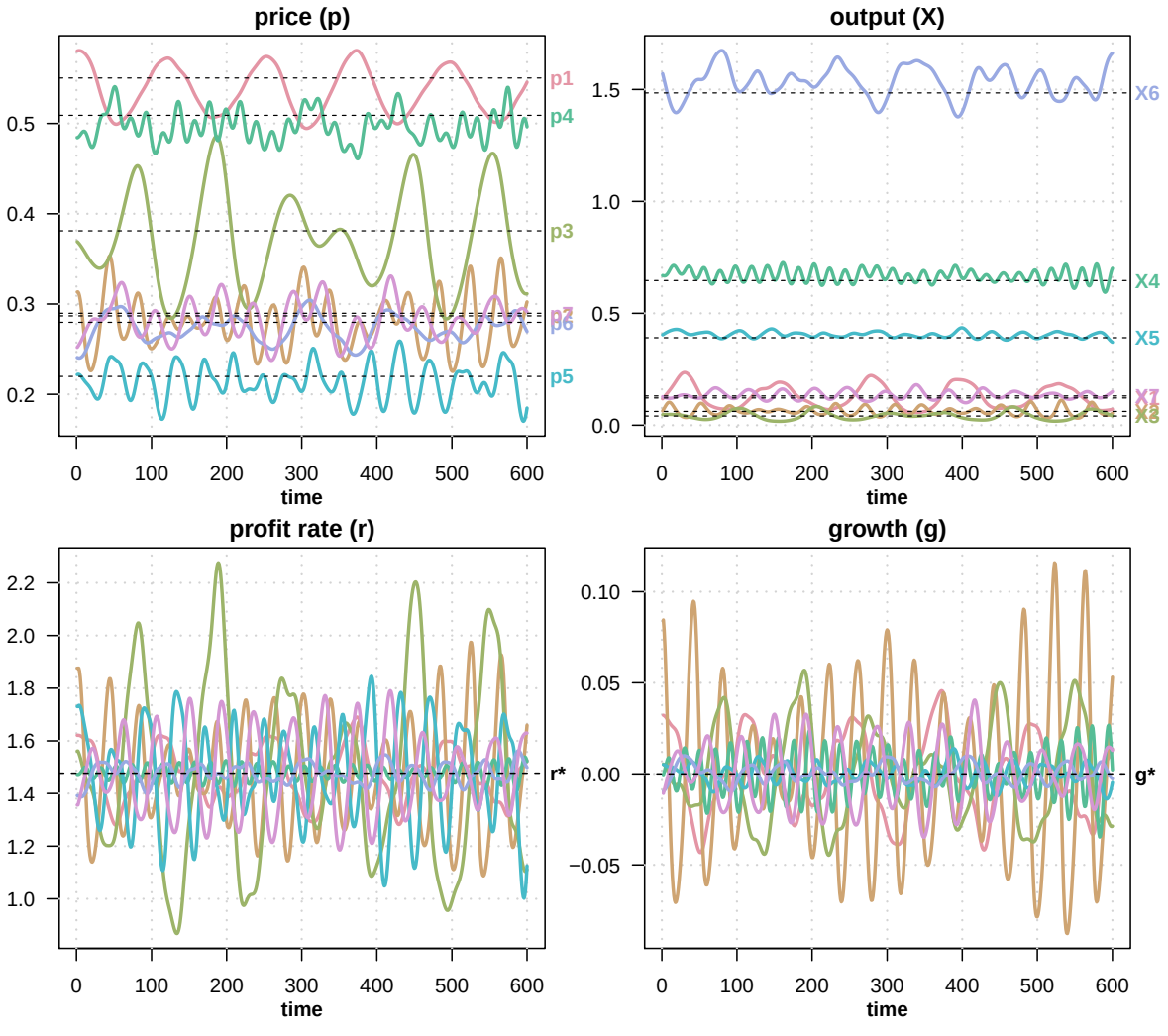
Economic Networks are Highly Hierarchical



Most Central Industries



Synthetic Cross-Dual Example for 7-sector US economy



Synthetic Cross-Dual Example

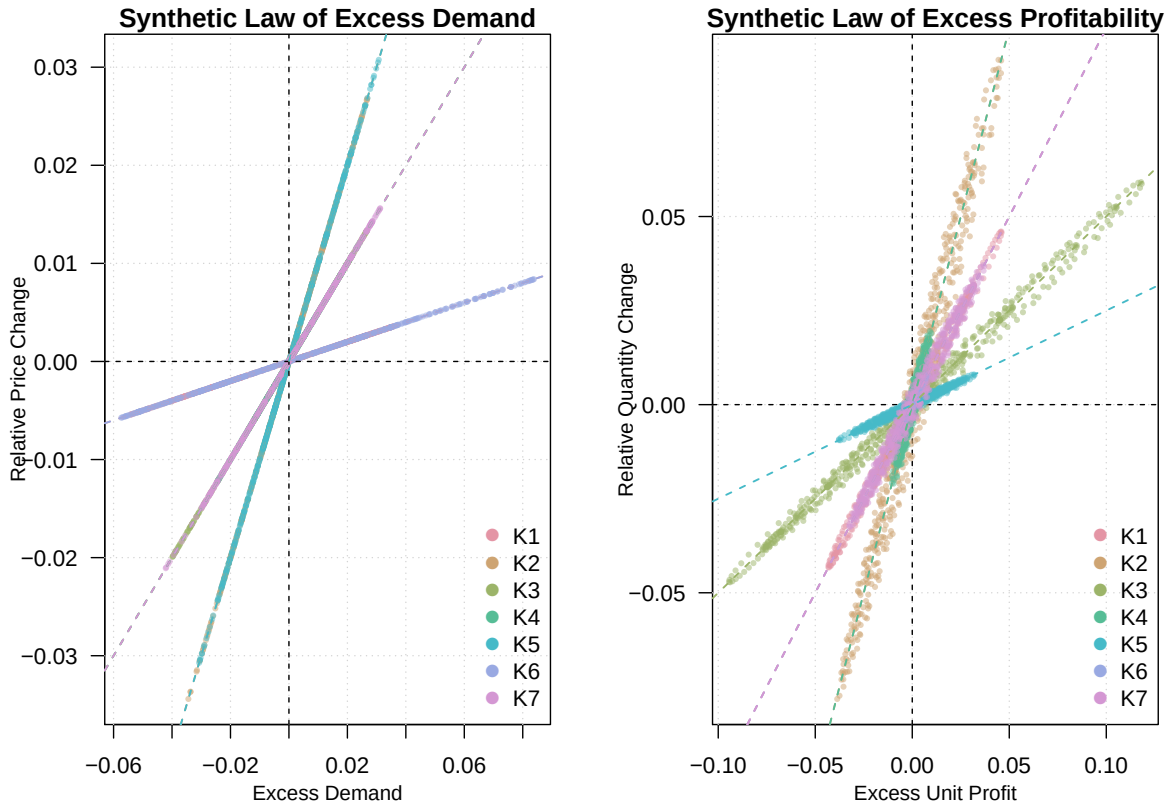
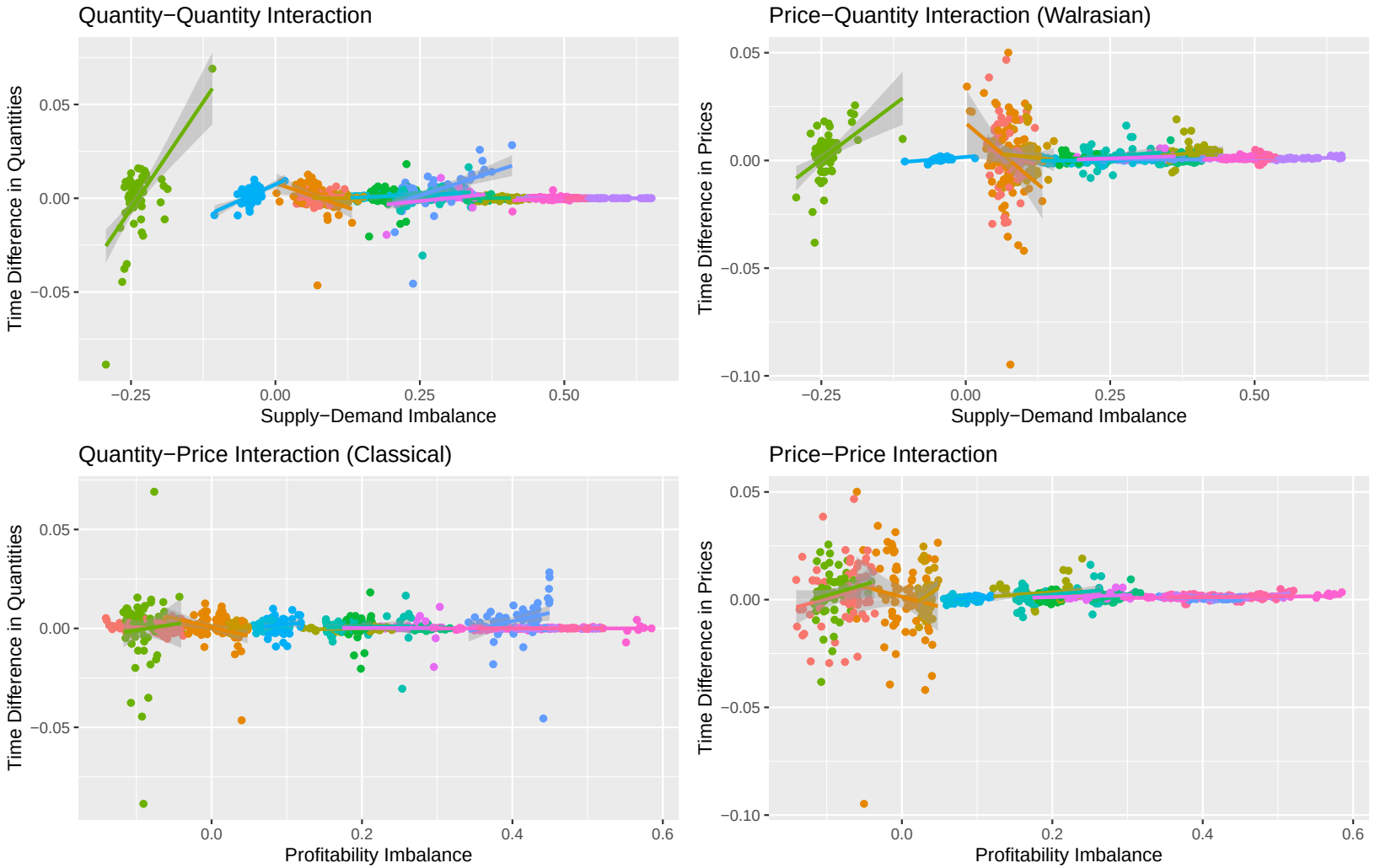
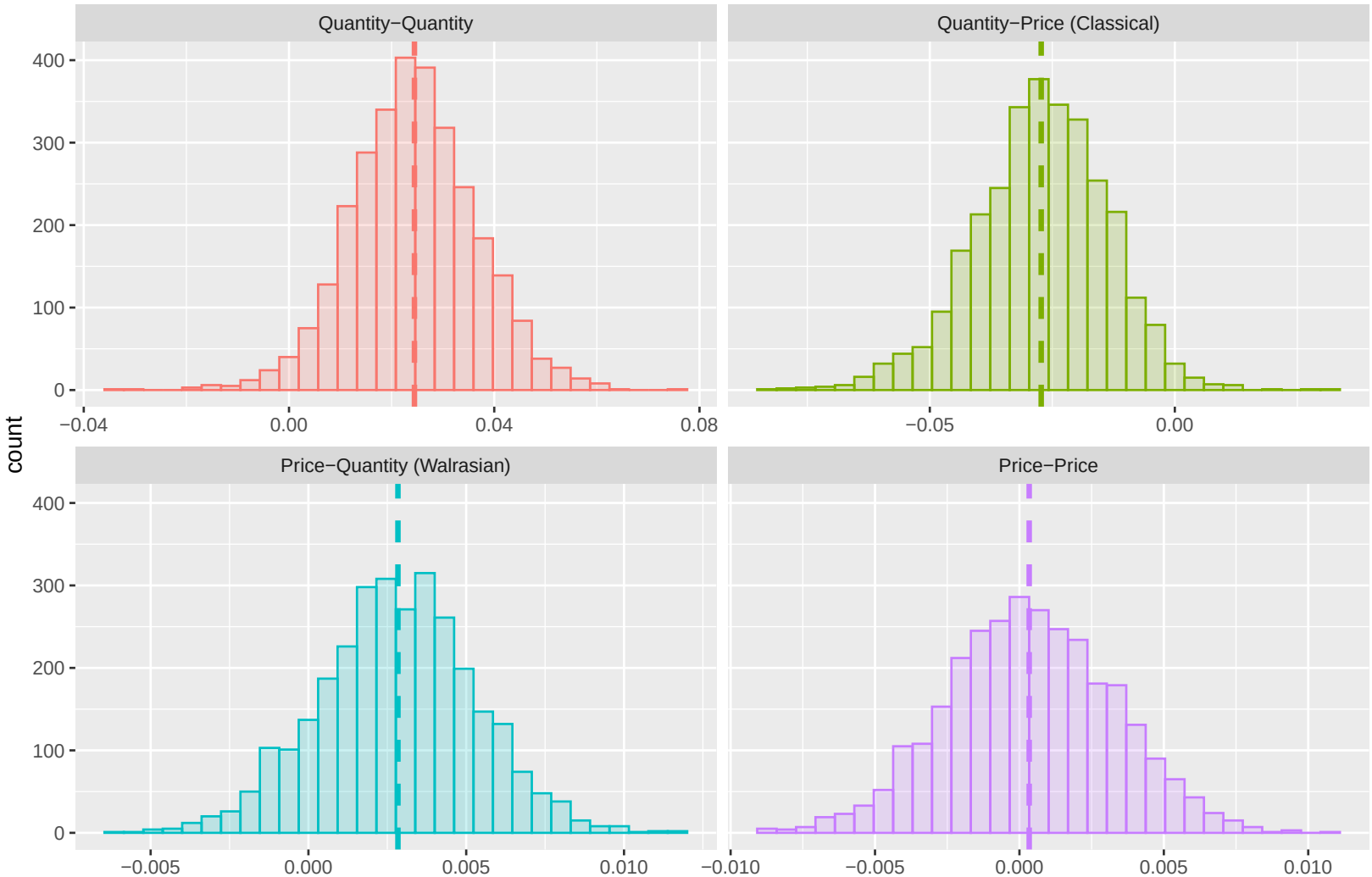


Figure: Linear slopes correspond to the adjustment parameters δ_p and δ_x. Regressions are of the simple form $y_t = \beta_k x_t + \varepsilon_t$ for sector k

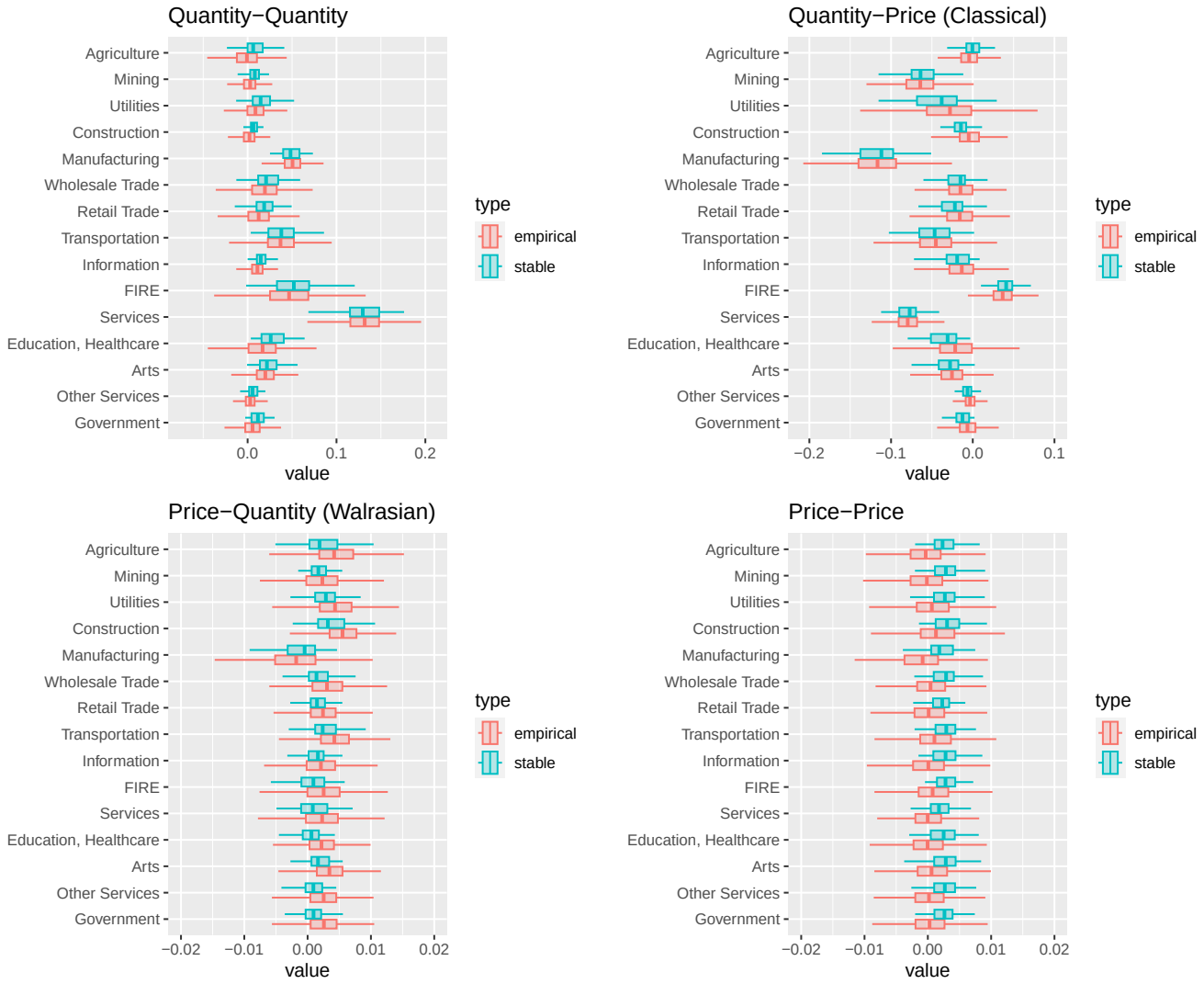
Empirical Imbalances: Composite Adjustments



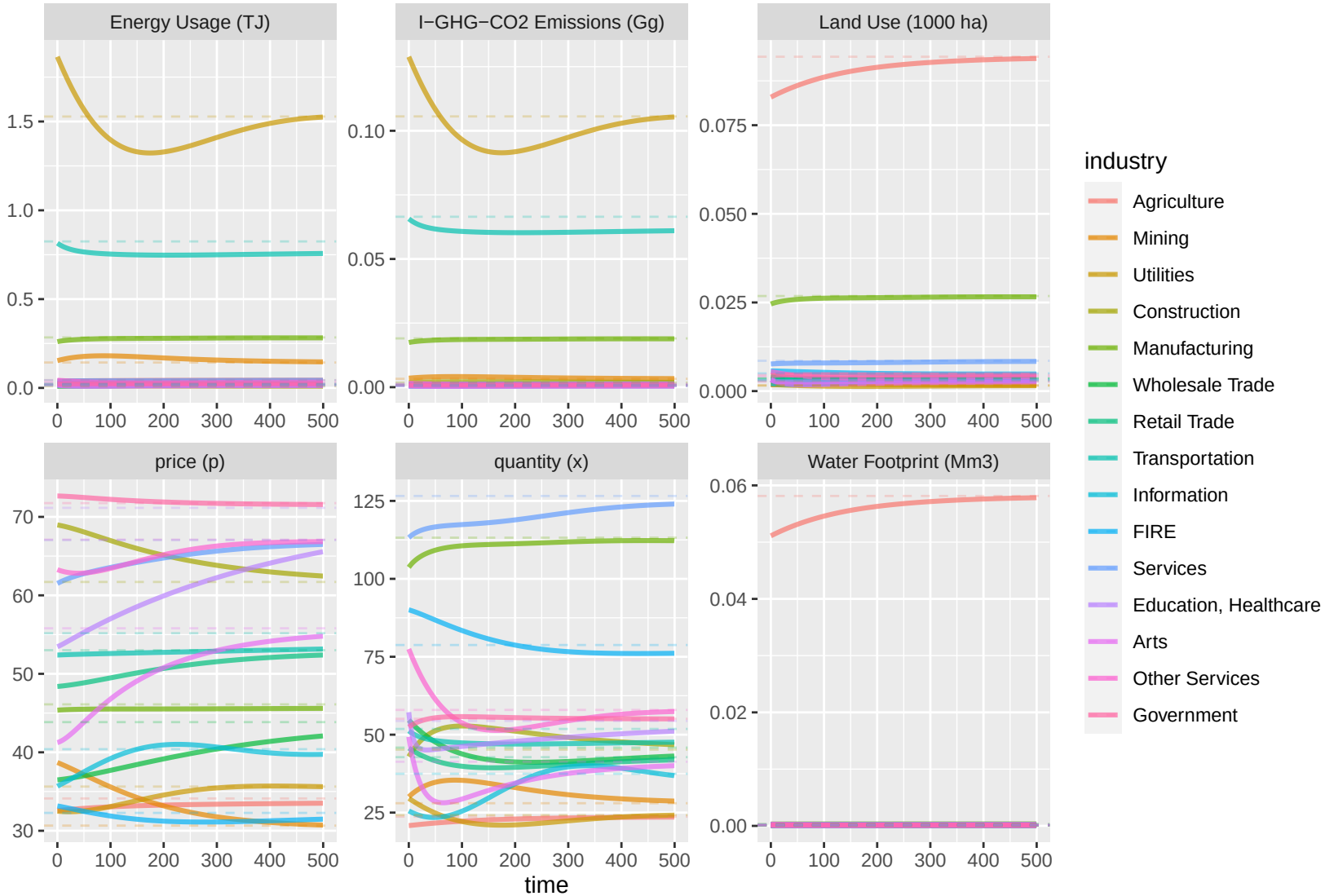
Posterior Distributions of the Fixed Effects



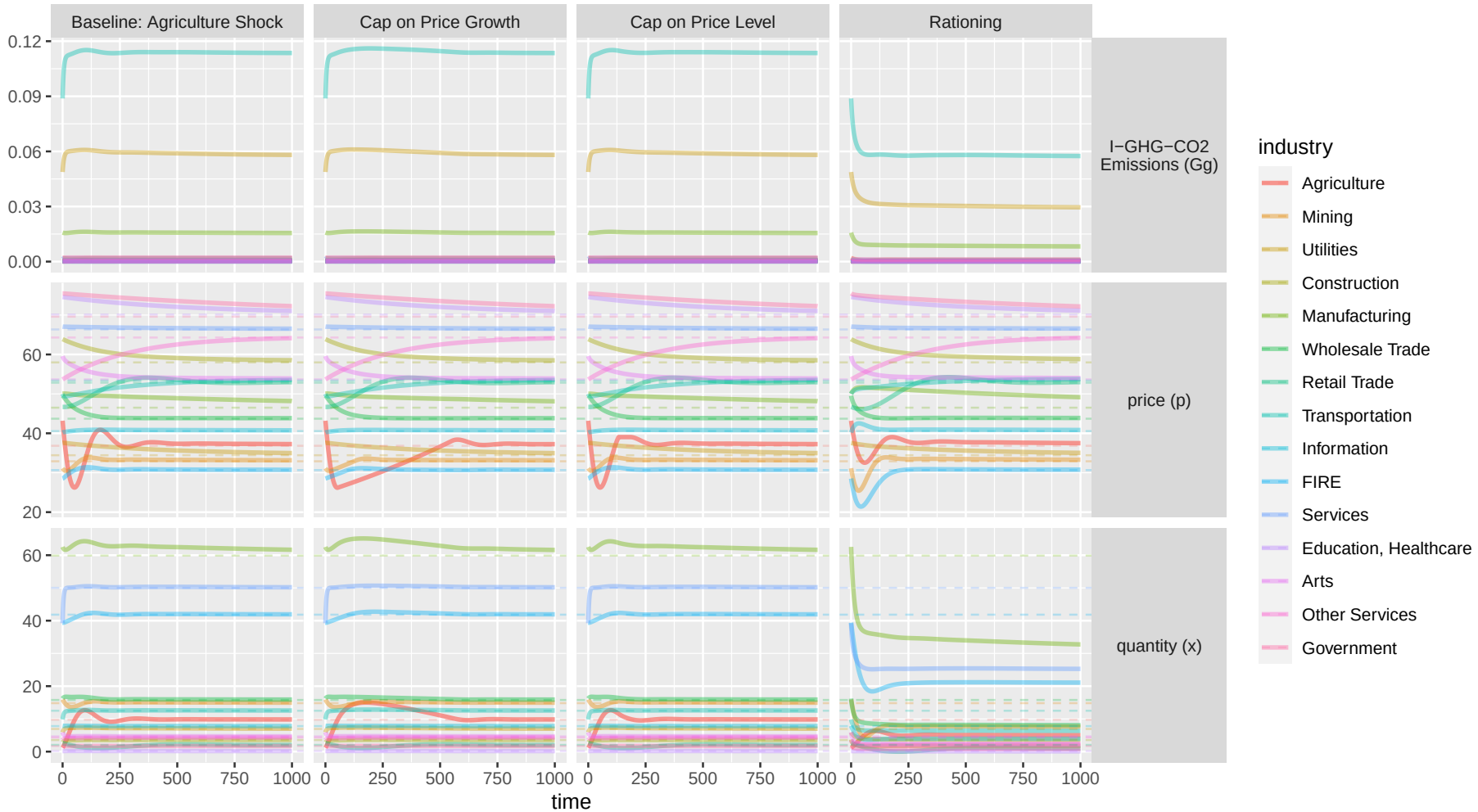
Posterior Distributions of Industry-Specific Random Effects



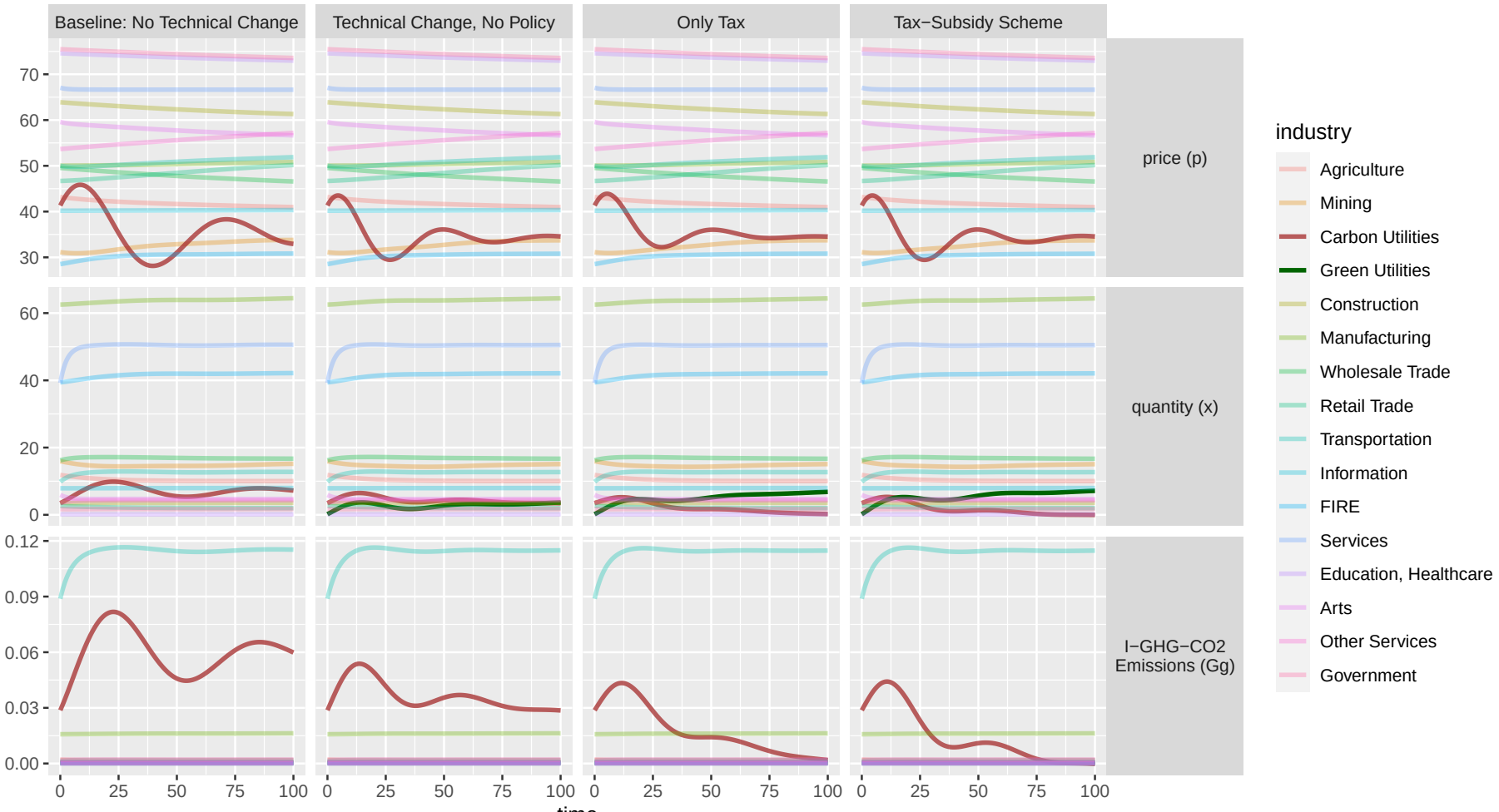
Ecologically-Extended Calibrated Simulations



Price Controls Reduce Economic Volatility



Tax-Subsidy Mixes Accelerate Decarbonization, Stabilize Prices



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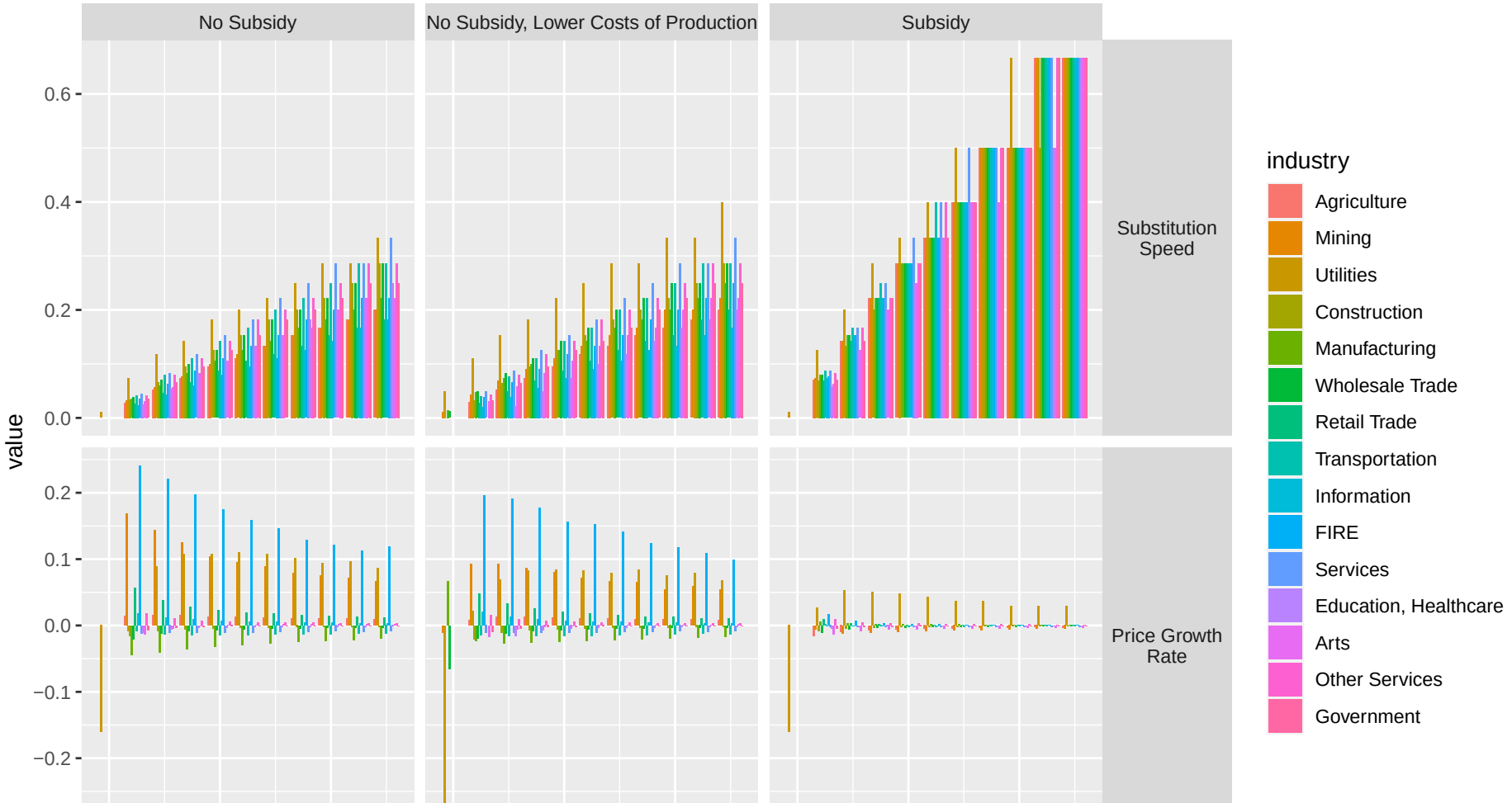
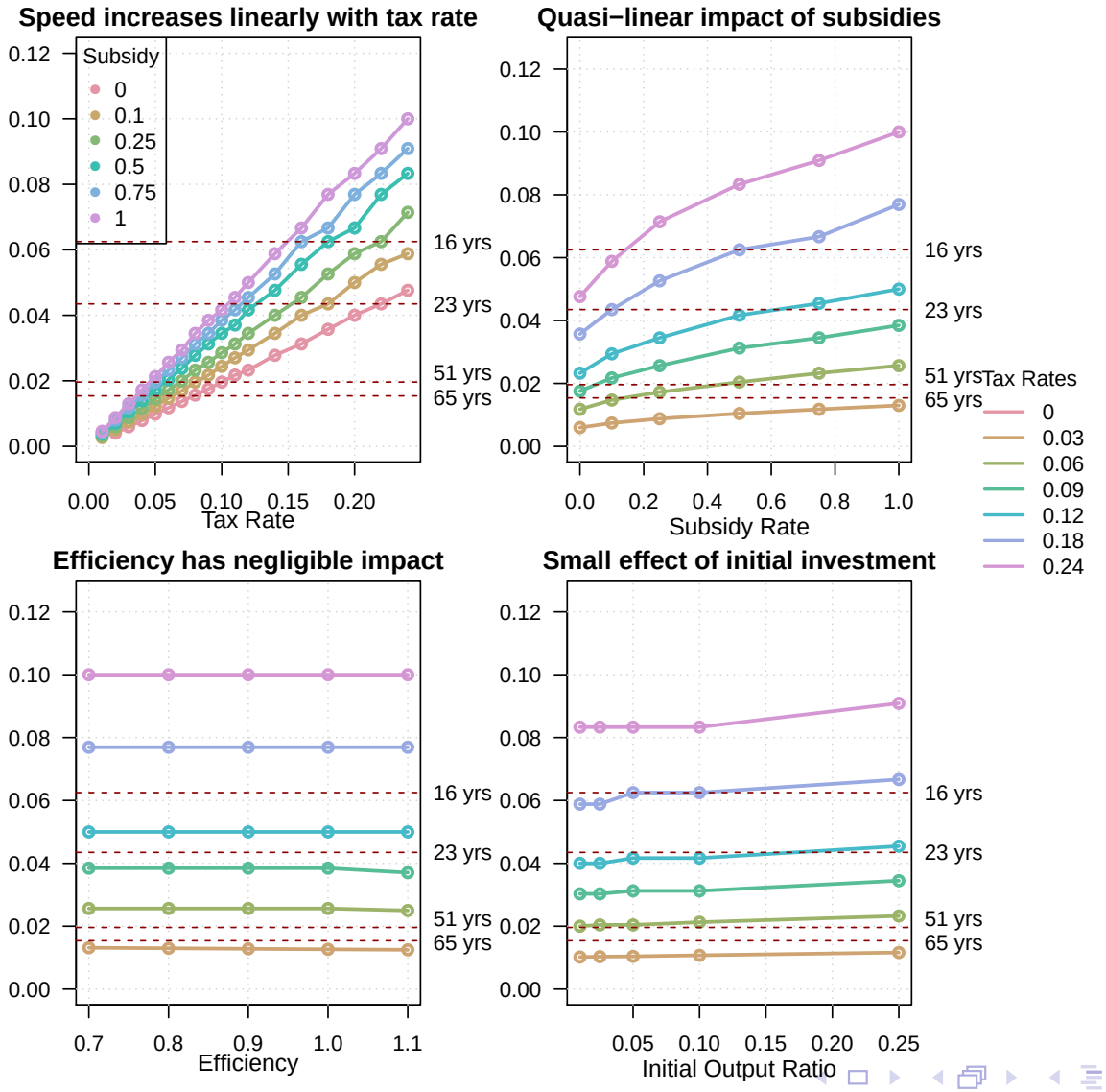


Assessing the Time Scales of the Low-Carbon Transition



Thank you!

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