



COMPLEXITY RENTS, UNEQUAL EXCHANGE, AND ECONOMIC DEVELOPMENT

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Main field of research

Computational Political Economy

Objectives

Objectives

[1] Estimate the causal effect of **economic complexity** on **value-added capture** at the global level

Economic complexity = ability to produce and export a diversified set of non-ubiquitous products

Value-added **capture** = value-added **realization** – value-added **production**

[2] Use **causal mediation** analysis to decompose the total long-run effect into its **direct** and **indirect** channels

[3] Compute the **non-linear cumulative long-run effect** using Bayesian econometrics

[4] Explain how the **complexity rent** hinders convergence of GDP per capita

Terminology

Terminology

Value-added = Value of total output – Value of non-labor inputs

Value-added **produced**:

Value-added measured in terms of **embodied, skill-adjusted labor**

Embodied labor = vertically integrated labor along global value chains

= direct labor + indirect labor (labor embodied in non-labor inputs)

Complex labor = non-linear skill adjustment

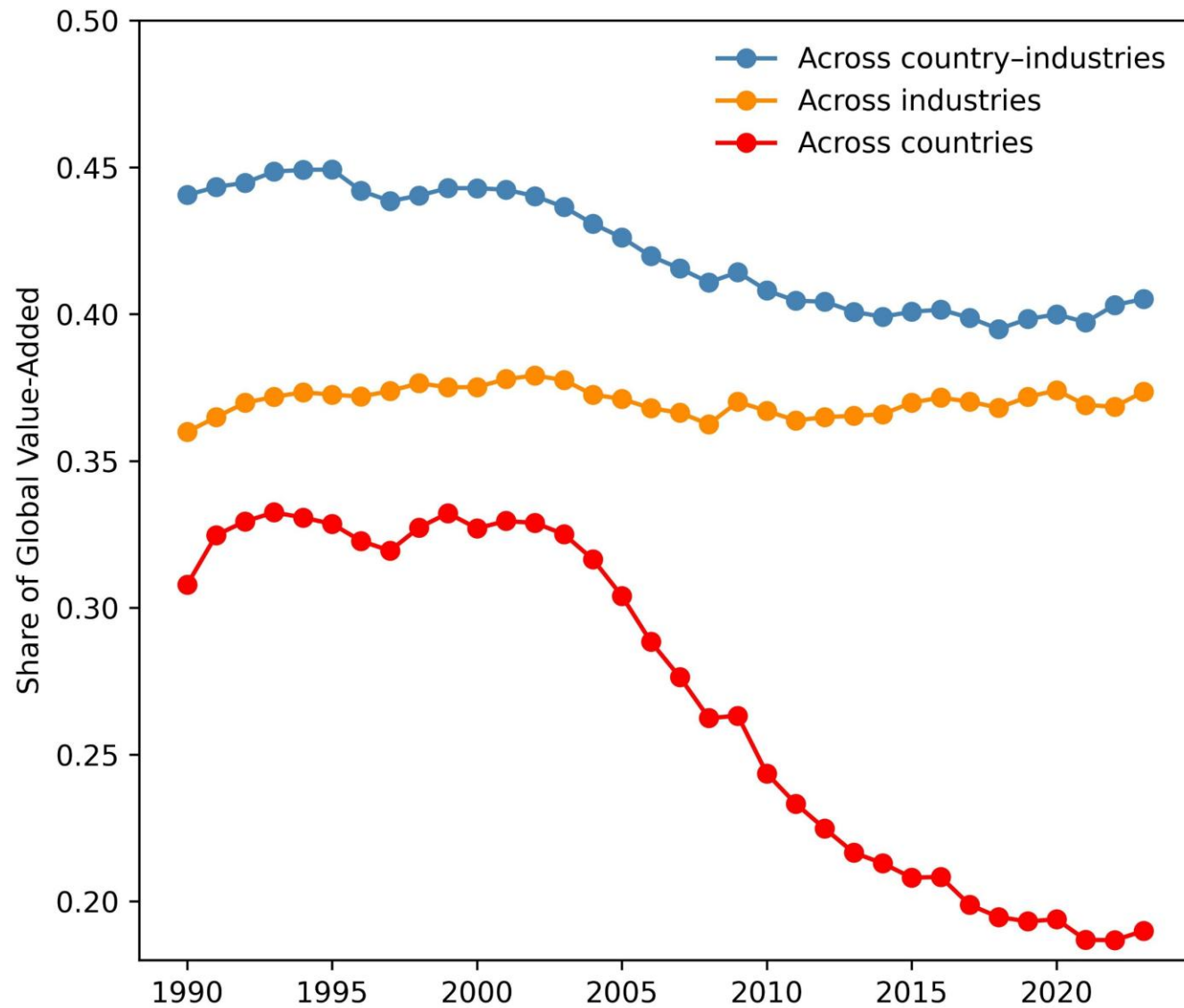
Value-added **realized**:

Value-added measured in **market prices in US dollars**

Value-added **capture** = value-added **realization** – value-added **production**

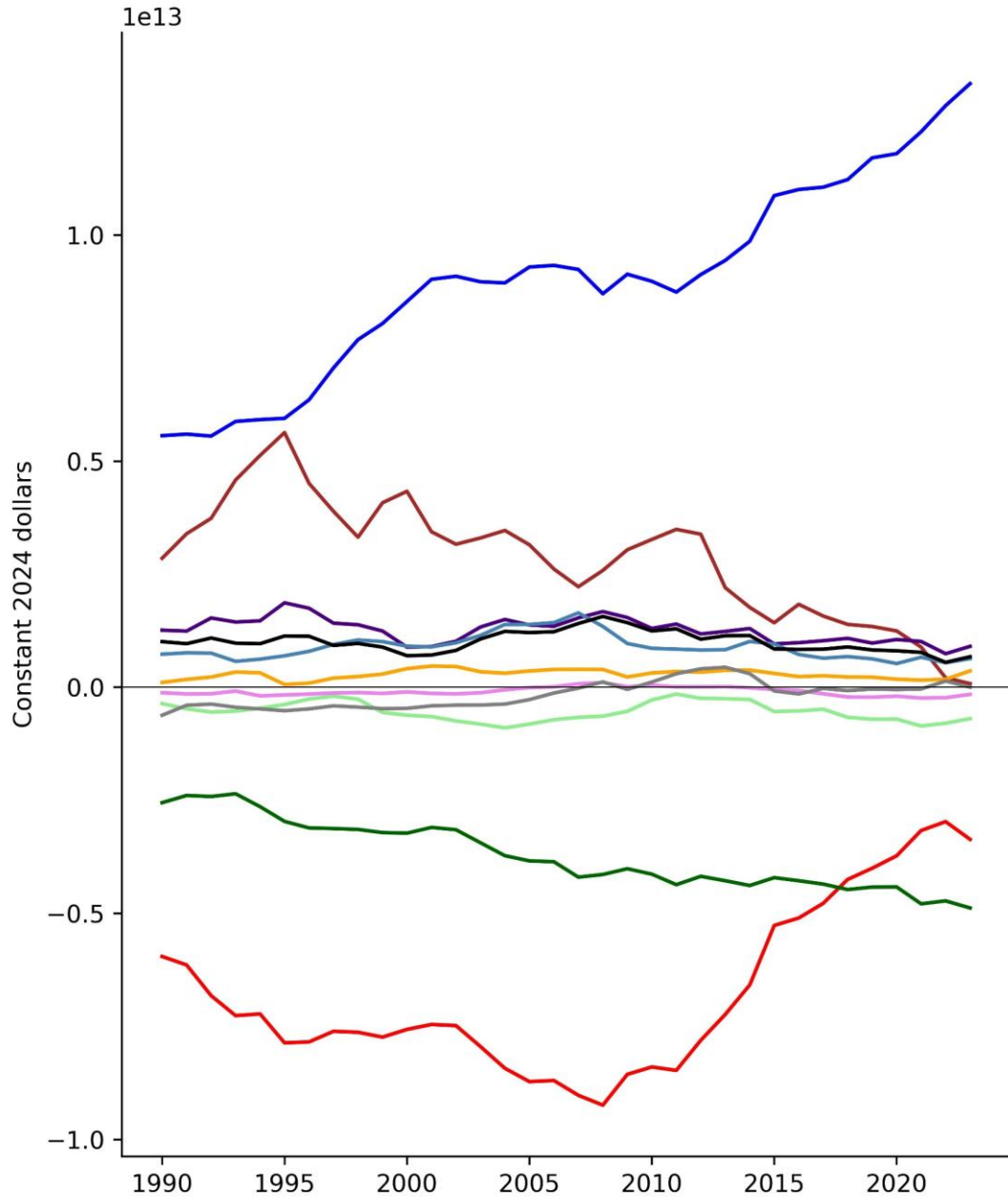
= **unequal exchange** of embodied labor

Unequal Exchange of Labor as a Share of Global GDP (1990-2023)

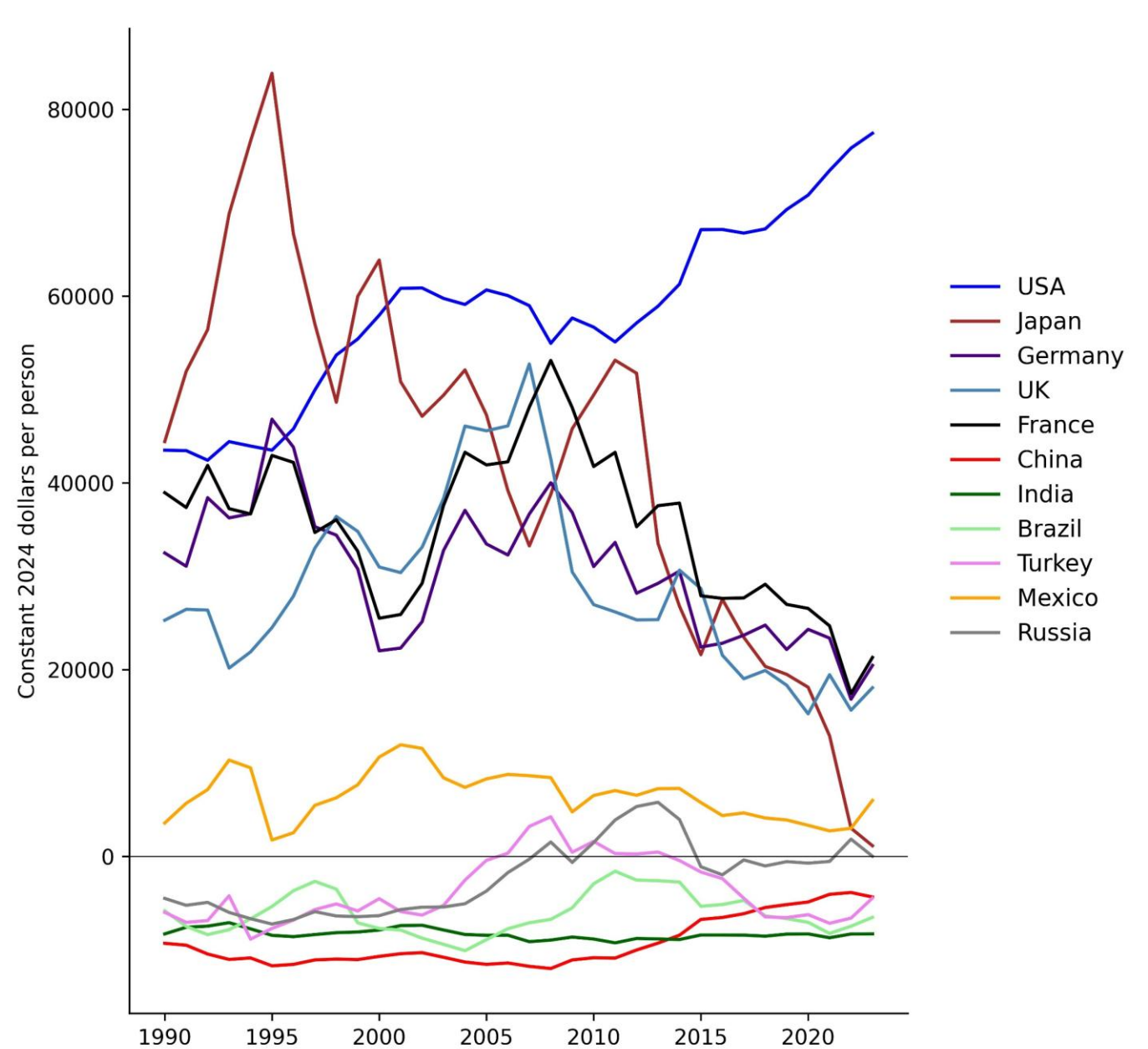


Value-Added Captured per Employee by Country (1990-2023)

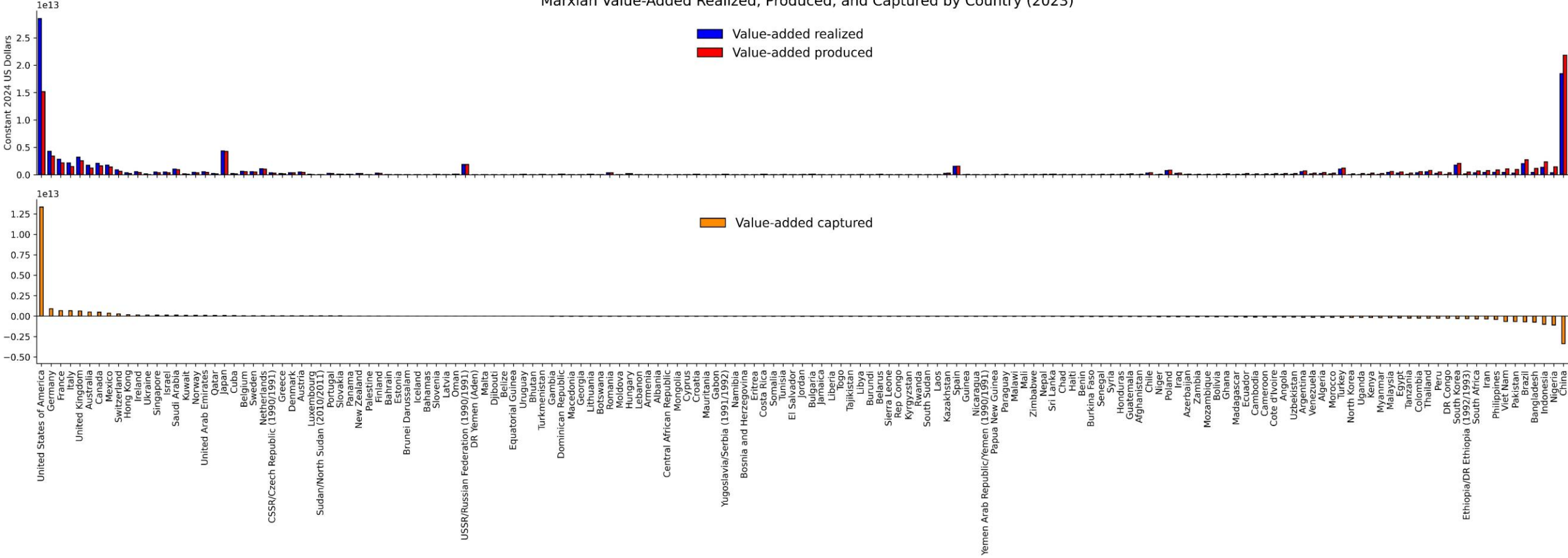
Value-Added Captured



Value-Added Captured per Employee



Marxian Value-Added Realized, Produced, and Captured by Country (2023)

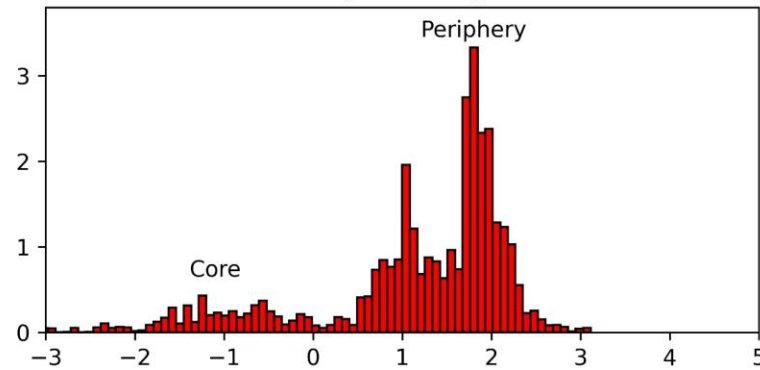


Core and Periphery

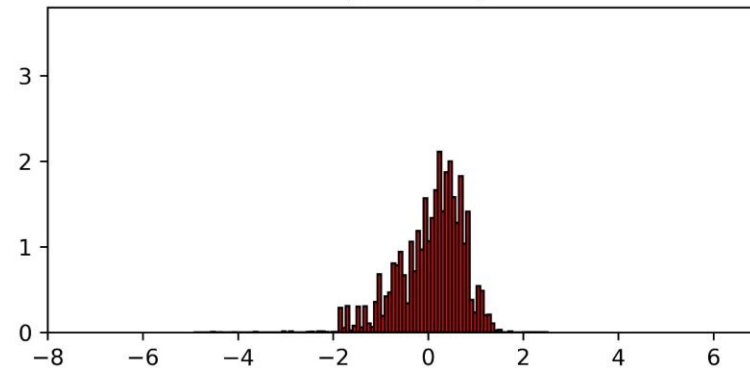
Produced and Realized Exploitation Rates (1990-2023)

Histograms in Logs, Weighted by the Share of Global Employment

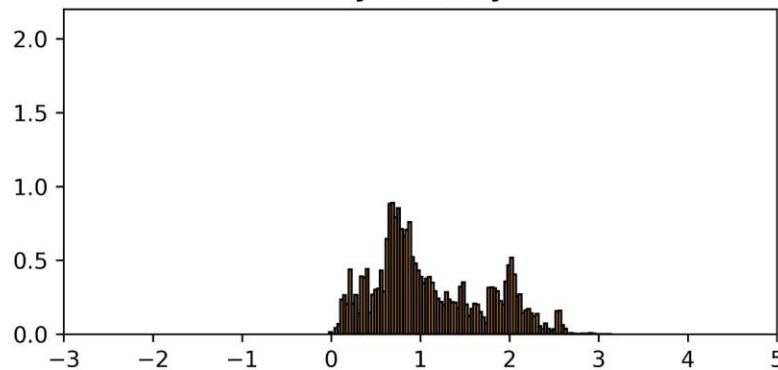
Produced Exploitation Rates By Country



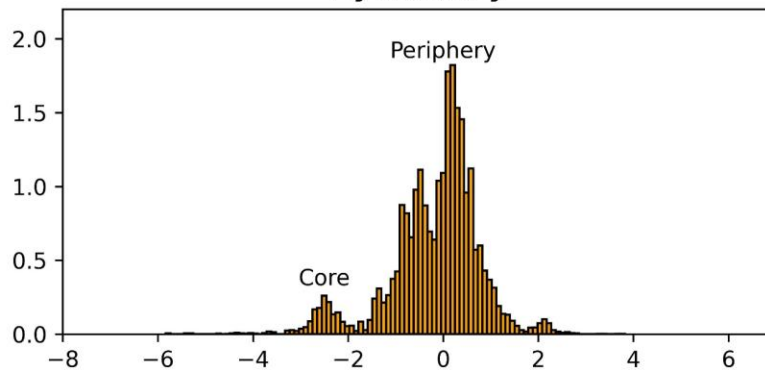
Realized Exploitation Rates By Country



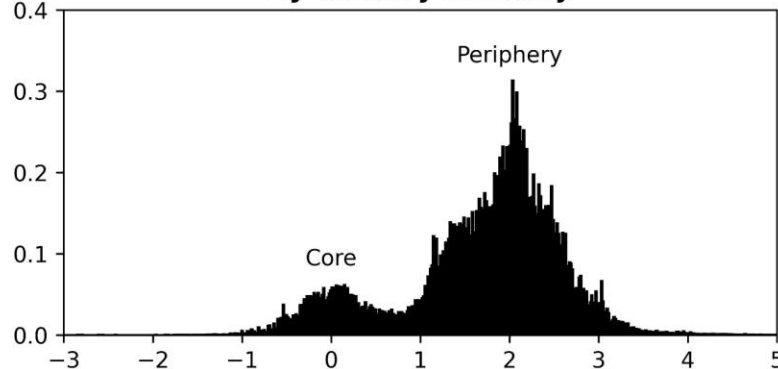
By Industry



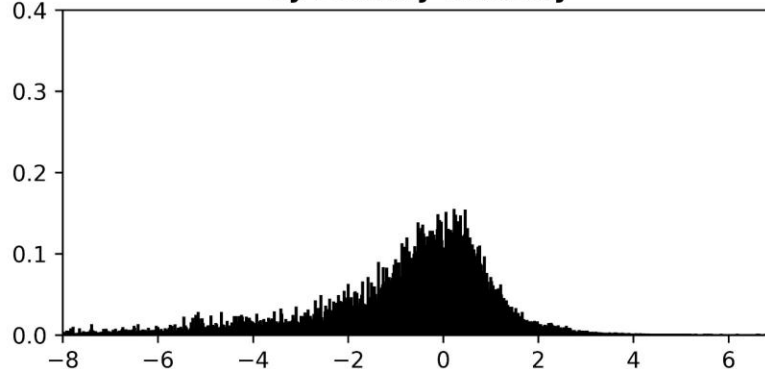
By Industry



By Country-Industry

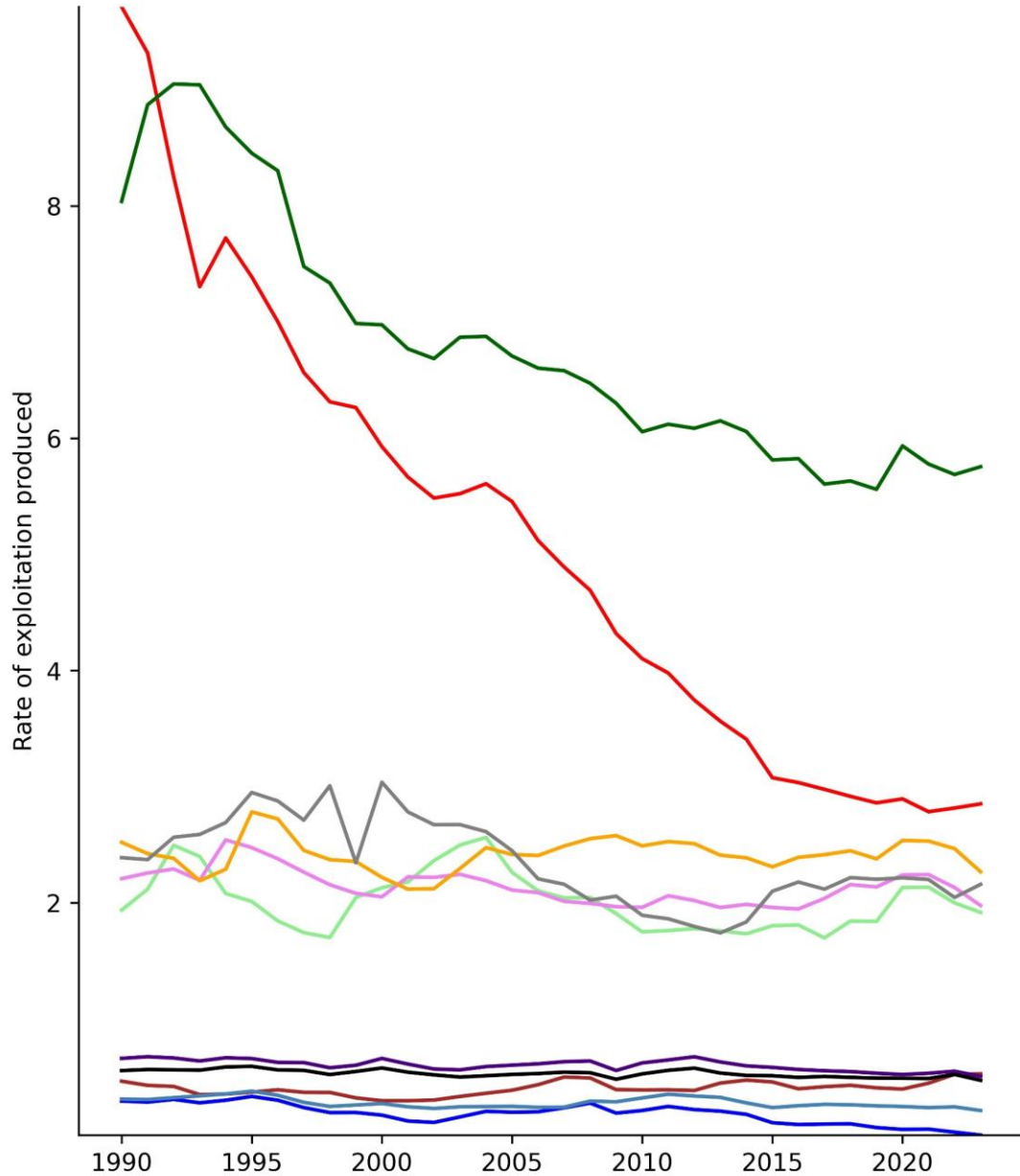


By Country-Industry

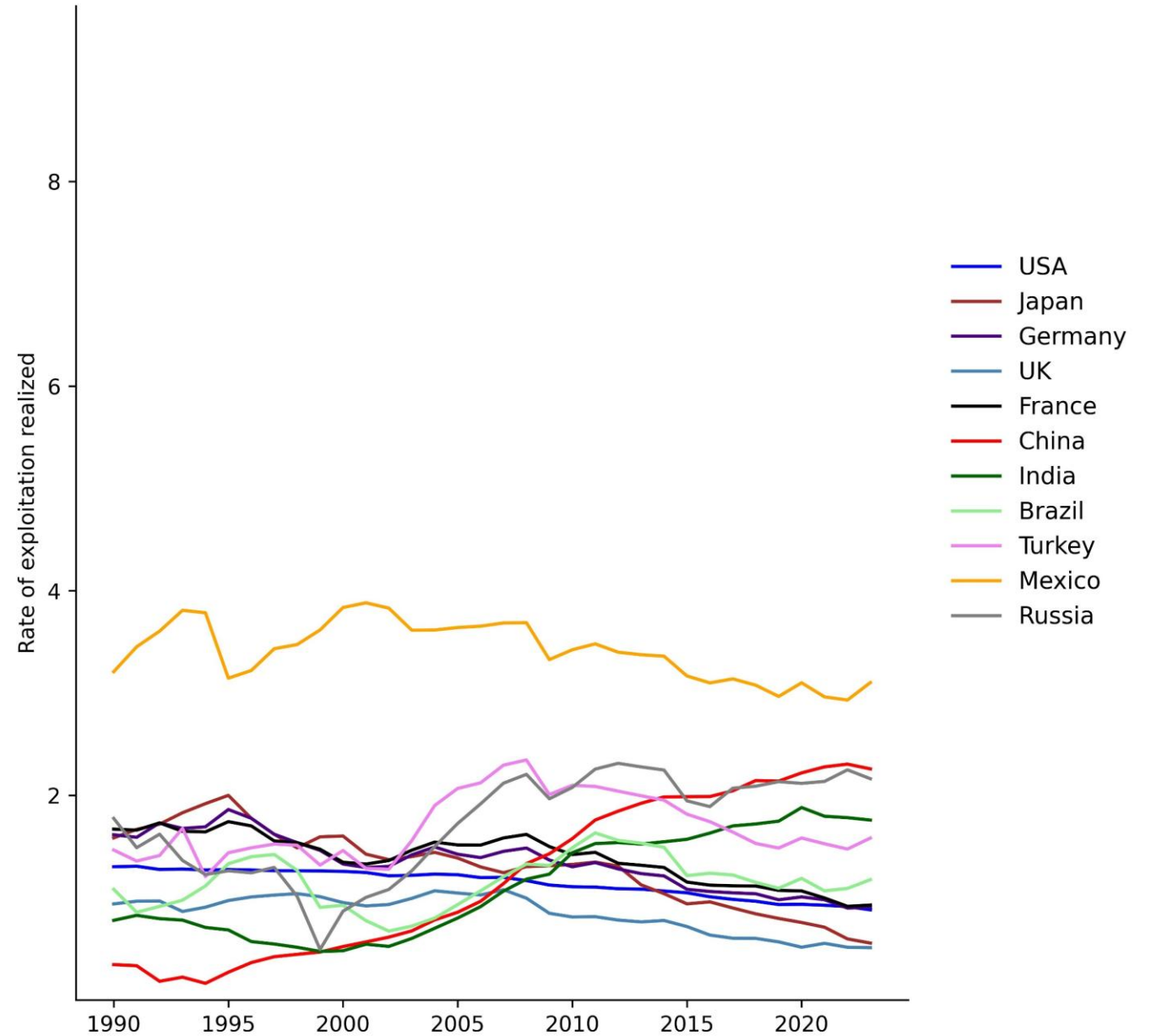


Exploitation Rates by Country (1990-2023)

Produced Exploitation Rates



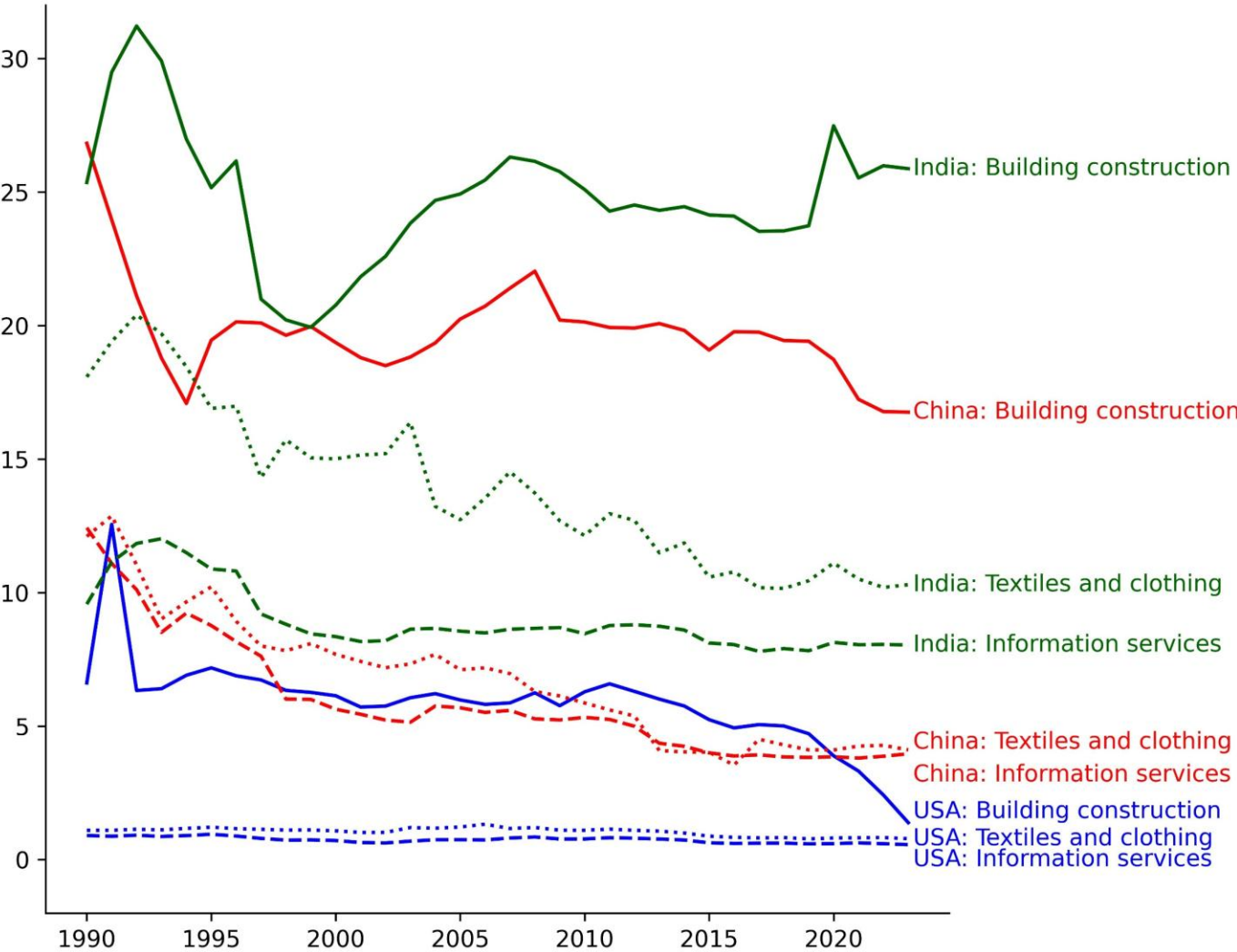
Realized Exploitation Rates



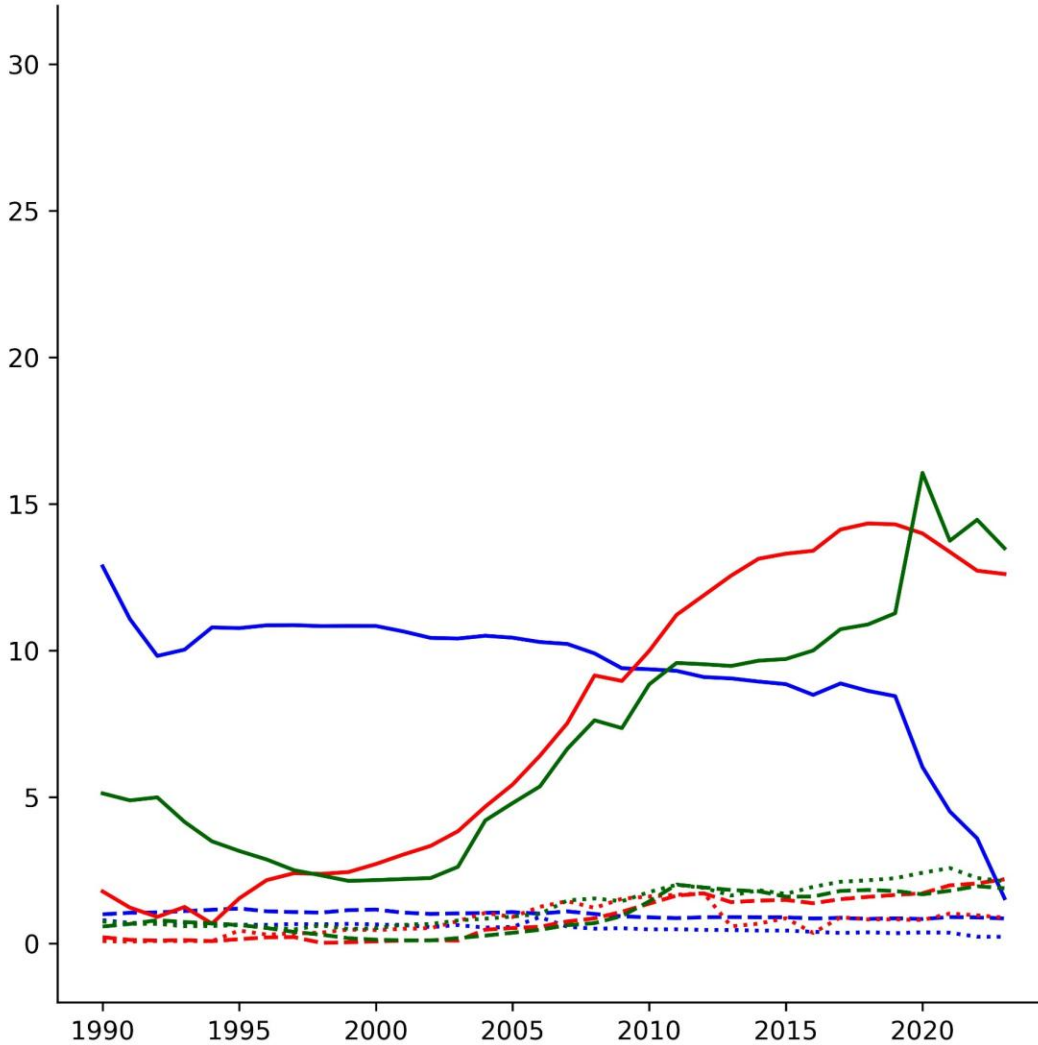
- USA
- Japan
- Germany
- UK
- France
- China
- India
- Brazil
- Turkey
- Mexico
- Russia

Exploitation Rates by Country-Industry (1990-2023)

Produced Exploitation Rates

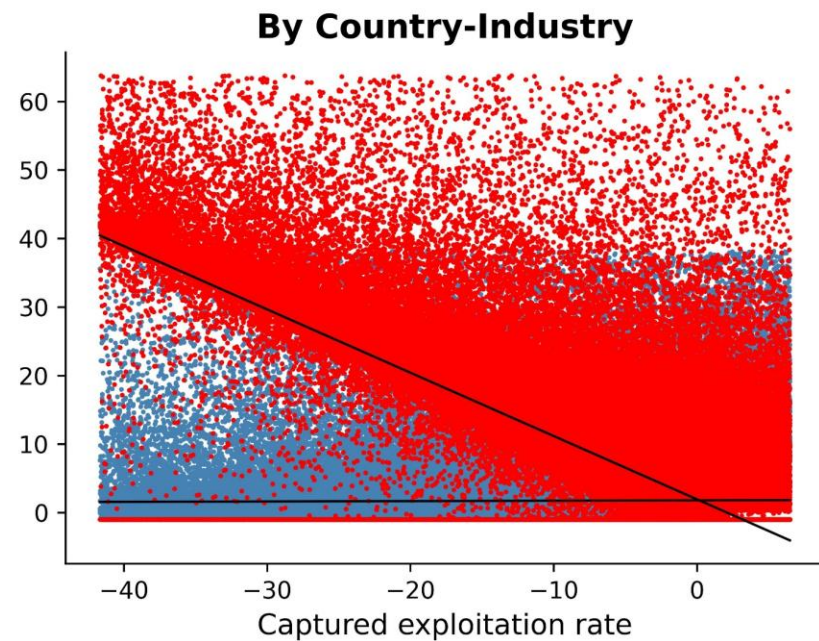
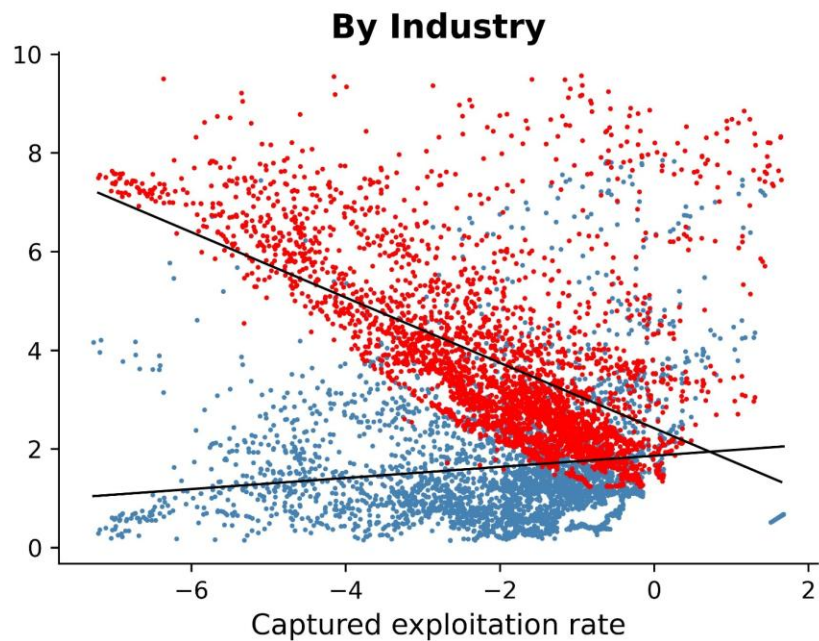
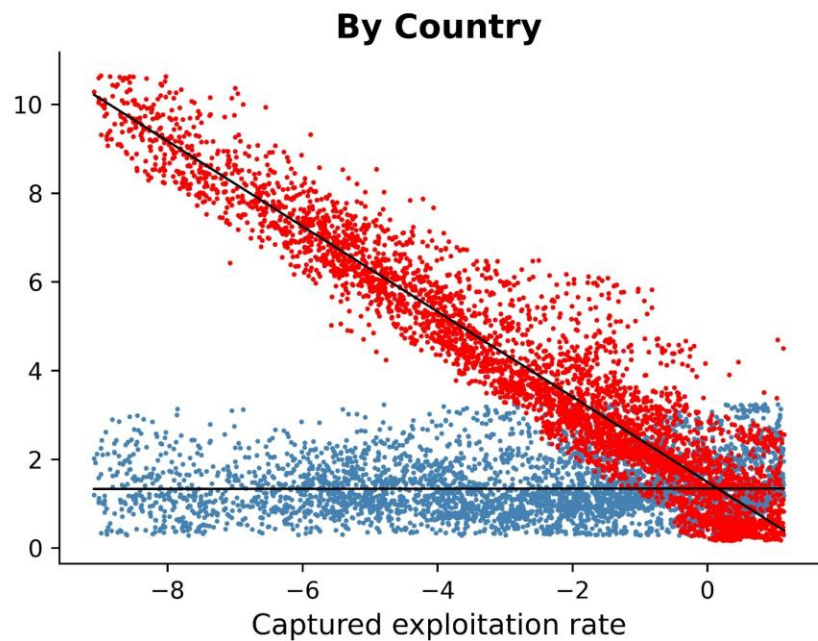


Realized Exploitation Rates



Exploitation Rates: Production, Realization, and Capture (1990-2023)

- Realized exploitation rate
- Produced exploitation rate



Relevance

Relevance

Why do complexity rents matter?

Complexity rent = value-added capture due to higher economic complexity

Countries with **higher** levels of **economic complexity**:

Realize more value-added than they **produce**

Capture value-added produced by less complex economies

Higher **output** prices + lower **input** prices + overvalued currencies

Countries with **lower** levels of **economic complexity**:

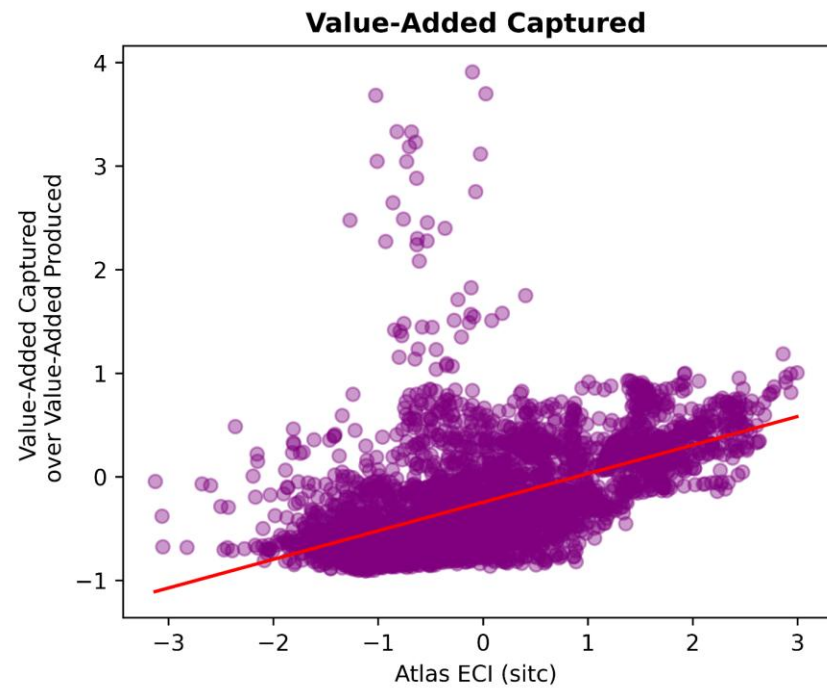
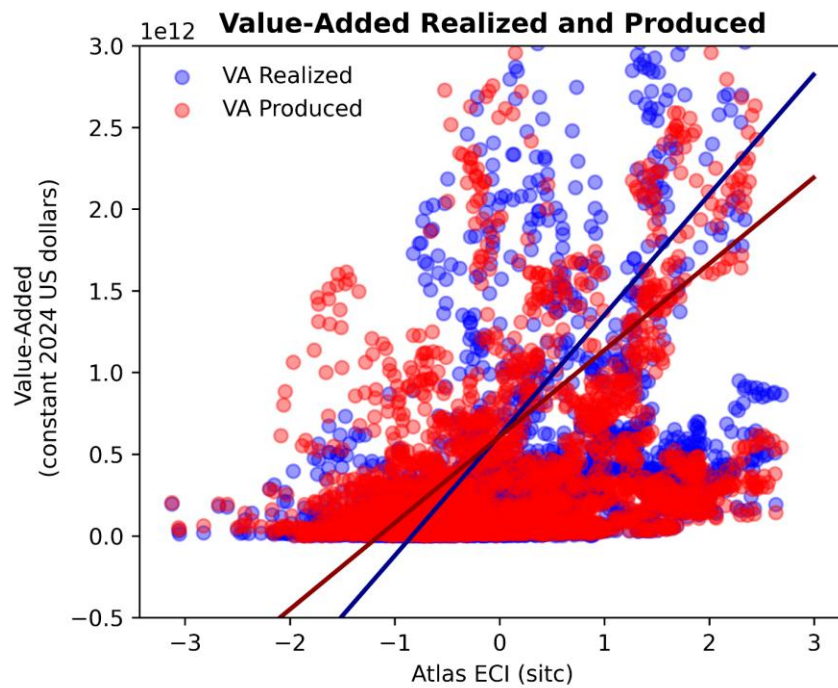
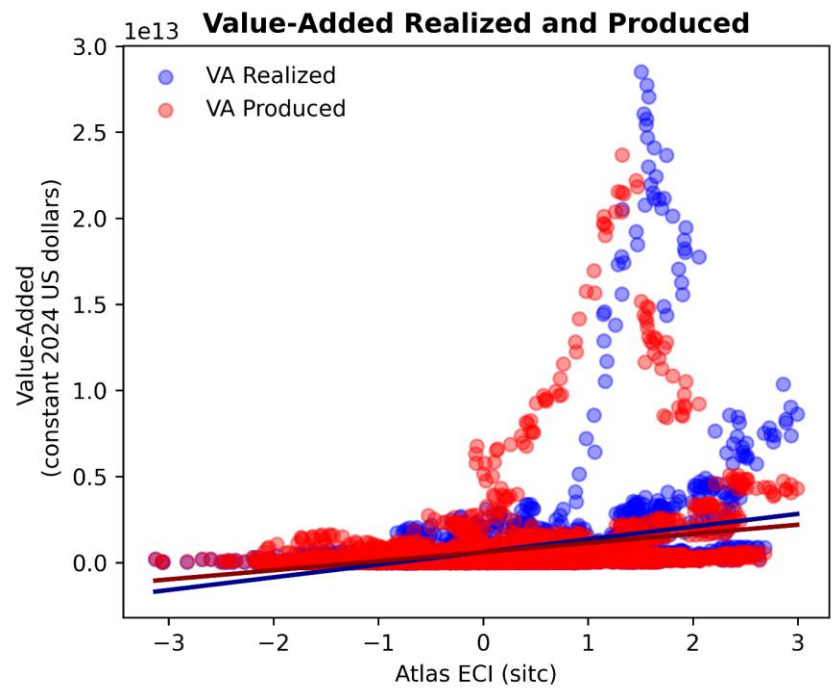
Realize less value-added than they **produce**

Transfer value-added produced to more complex economies

Lower **output** prices + higher **input** prices + undervalued currencies

Value-Added Realized, Produced, and Captured as a Function of Economic Complexity (1995-2023)

Marxian Productive-Unproductive Classification with Heterogeneous Labor (Adjusted for Skill)
Atlas ECI Based on sitc Classification



Relevance

Complexity rents make the global economy substantially more **unequal**

Value-added capture = **unequal exchange** in embodied labor

Less complex economies **transfer value-added** away to more complex economies

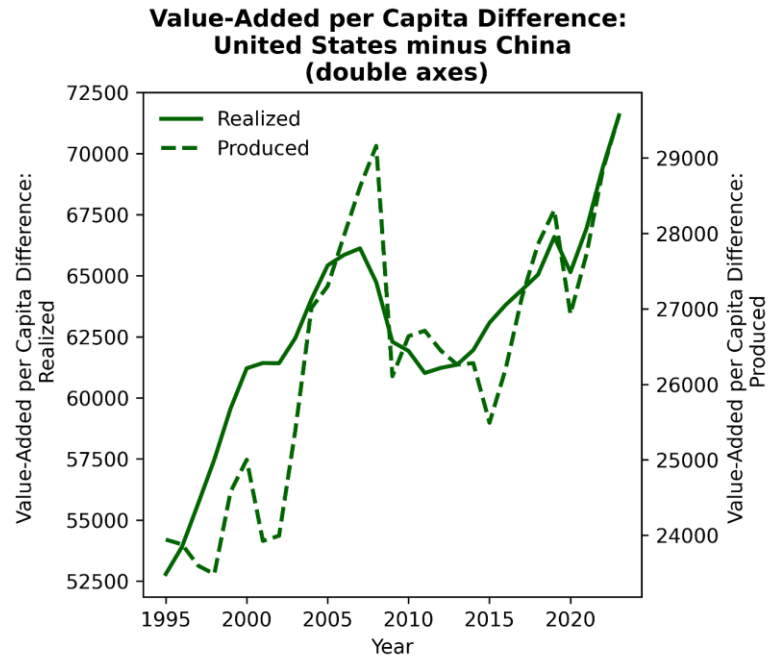
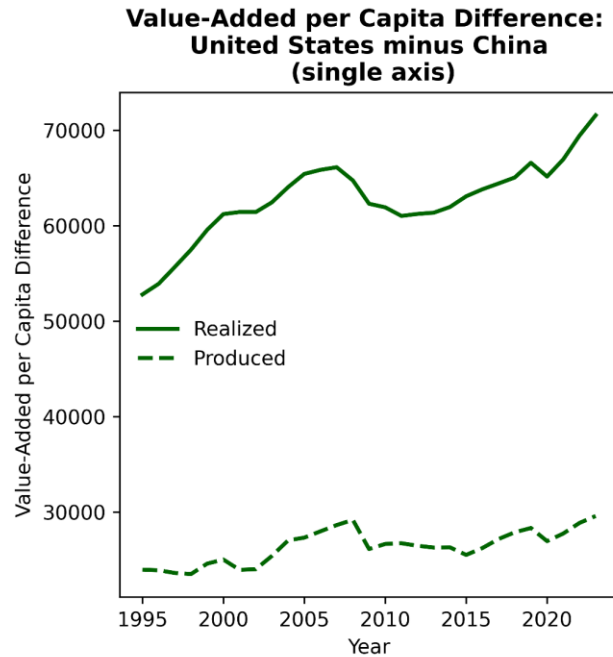
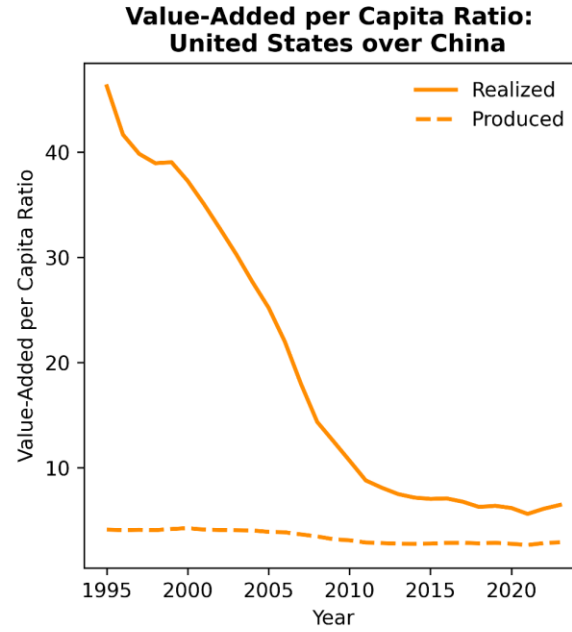
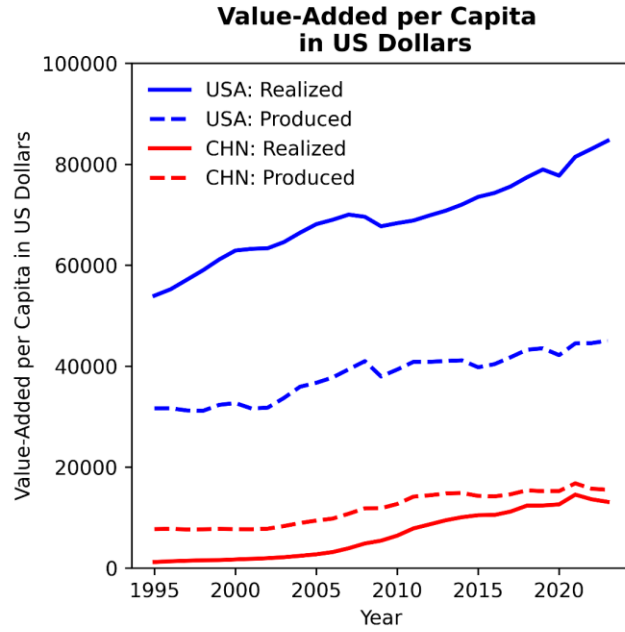
More complex economies **appropriate value** they have not produced

The complexity rent:

Hinders convergence in GDP per capita across countries

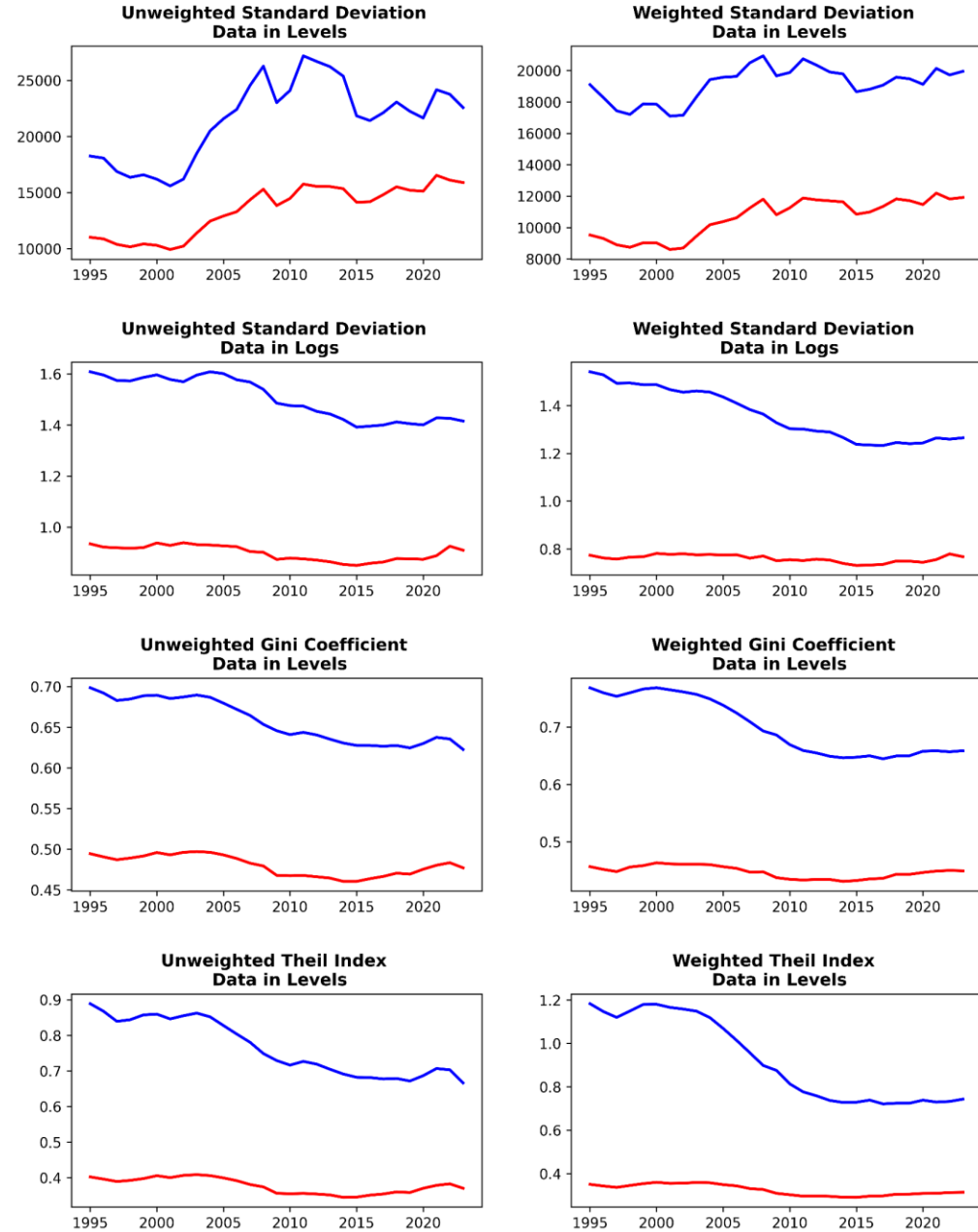
Causes **uneven economic development**

Value-Added Produced and Realized per Capita: United States and China (1995-2023)



Value-Added Produced and Realized per Capita: Measures of Dispersion Across Countries (1995-2023)

— Value-Added per Capita: Realized
— Value-Added per Capita: Produced



Relevance

Greater economic complexity:

Enables countries to **produce** more value-added

But it also enables them to **realize** more value-added than they **produce**

Value **realization** rises more than proportionally as economic complexity increases

Value **capture** rises as economic complexity increases

Complex economies extract **complexity rents** from less complex economies

The paper develops a methodology to estimate:

The **effect** of complexity rents on value capture across countries, over 1995-2021

How much more **unequal** the world economy becomes due to complexity rents

Methodology

Methodology

The theoretical framework brings together:

[1] **New Interpretation** of Marxian value theory

Foley, Duménil, Mohun, Veneziani, Cogliano, Yoshihara, Basu, Flaschel

[2] **Leontief input-output model**

Leontief inverse matrix

The paper combines these two models and generalize them to the global economy:

Global Leontief inverse matrix = global value chains

Global MELT = principle of value conservation at the world level

MELT = monetary expression of labor time = conversion of labor time into US dollars

Methodology

Development of a **new model** of **global value-added capture** across different levels of aggregation:

Countries

Industries

Country-industries

Global aggregates

Estimation using **global input-output data** from GLORIA v060

164 countries and regions

120 sectors per region

34 years: 1990-2023

1.2 terabytes of input-output data

Methodology

Minimum hardware requirements:

Cloud computing (GCC, Azure, AWS)

Python (R does not have native access to the GPU and will not work)

Nvidia A100 GPU: 6,912 CUDA cores

80Gb of VRAM

\$20,000



Methodology

Creation of **new panel datasets**:

GLORIA + Atlas of Economic Complexity + Word Development Indicators (WDI)

137 countries over 1995-2023

Different classifications of **productive** and **unproductive** activities

Different methods to compute **value-added production** and **skill adjustment**

New panel datasets are available at the Zenodo public repository:

<https://doi.org/10.5281/zenodo.19052546>

<https://doi.org/10.5281/zenodo.19282977>

Methodology

Productive activities

Create **new** products and services embodying **value**

Value = total (direct and indirect) embodied labor, adjusted for skill

Use-value = social usefulness

Unproductive activities

No production of value-added

No **direct** contribution of new value to the economy

Examples: finance, real estate, trade, gov administration, national defense

But can **indirectly** enable or hinder productive activities

Ultimately paid from the value-added created by **productive activities**

Methodology

Robustness tests:

Marxian approach (productive vs. unproductive activities)

Conventional approach (SNA, all activities are productive)

Homogeneous labor (no adjustment for skills)

Heterogeneous labor (skills are proportional to relative wages)

Heterogeneous labor (non-linear adjustment of skills to relative wages)

Econometric Analysis

Econometric Analysis

Objective:

Estimate the **causal effect** of **economic complexity** on **value-added capture** at the global level

Econometric model:

Structural equation model (SEM) with 5 equations + 1 exogenous variable

VA = Value-added capture over value-added production

ECI = Economic complexity index

RER = Currency overvaluation relative to PPP

CA = Current account surplus

UA = Share of unproductive activities

Oil = Oil rents (exogenous control)

Econometric Analysis

Identification strategy:

Slow-moving variables have a contemporaneous effect on **fast**-moving variables

Fast-moving variables do **not** have a contemporaneous effect on **slow**-moving variables

Fast-moving variables affect **slow**-moving variables only through lagged effects

Causal mediation analysis:

Isolates the **direct** and **indirect** effects of ECI on VA capture

The model computes the **cumulative long-effect effect** of ECI on VA capture

Need to use **Bayesian** methods because the long-run effect is highly **non-linear**

The paper compares the **Bayesian** and **system-GMM** estimators

Lags used as internal weak instruments (IVs)

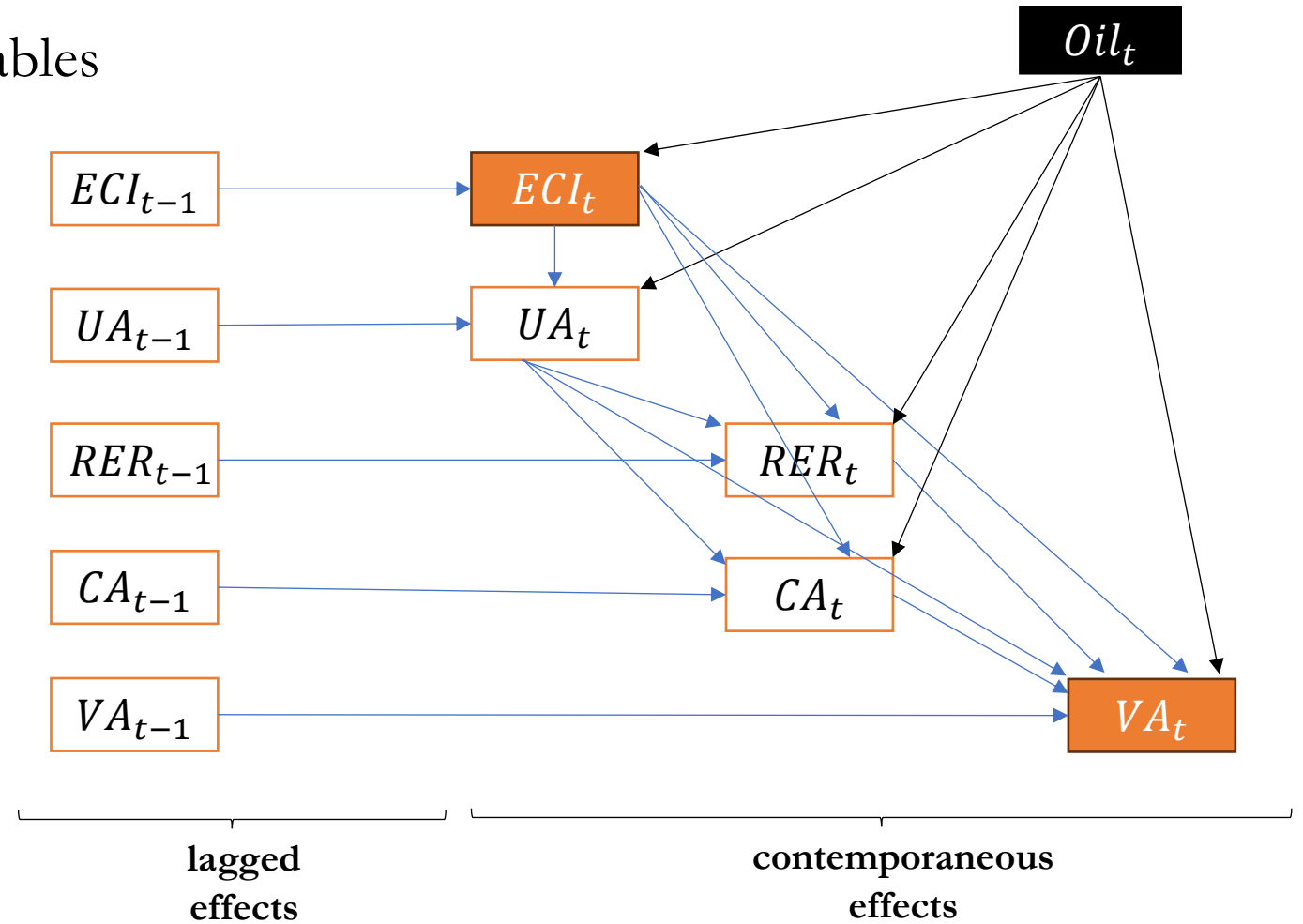
Econometric Analysis

ECI: slowest variable

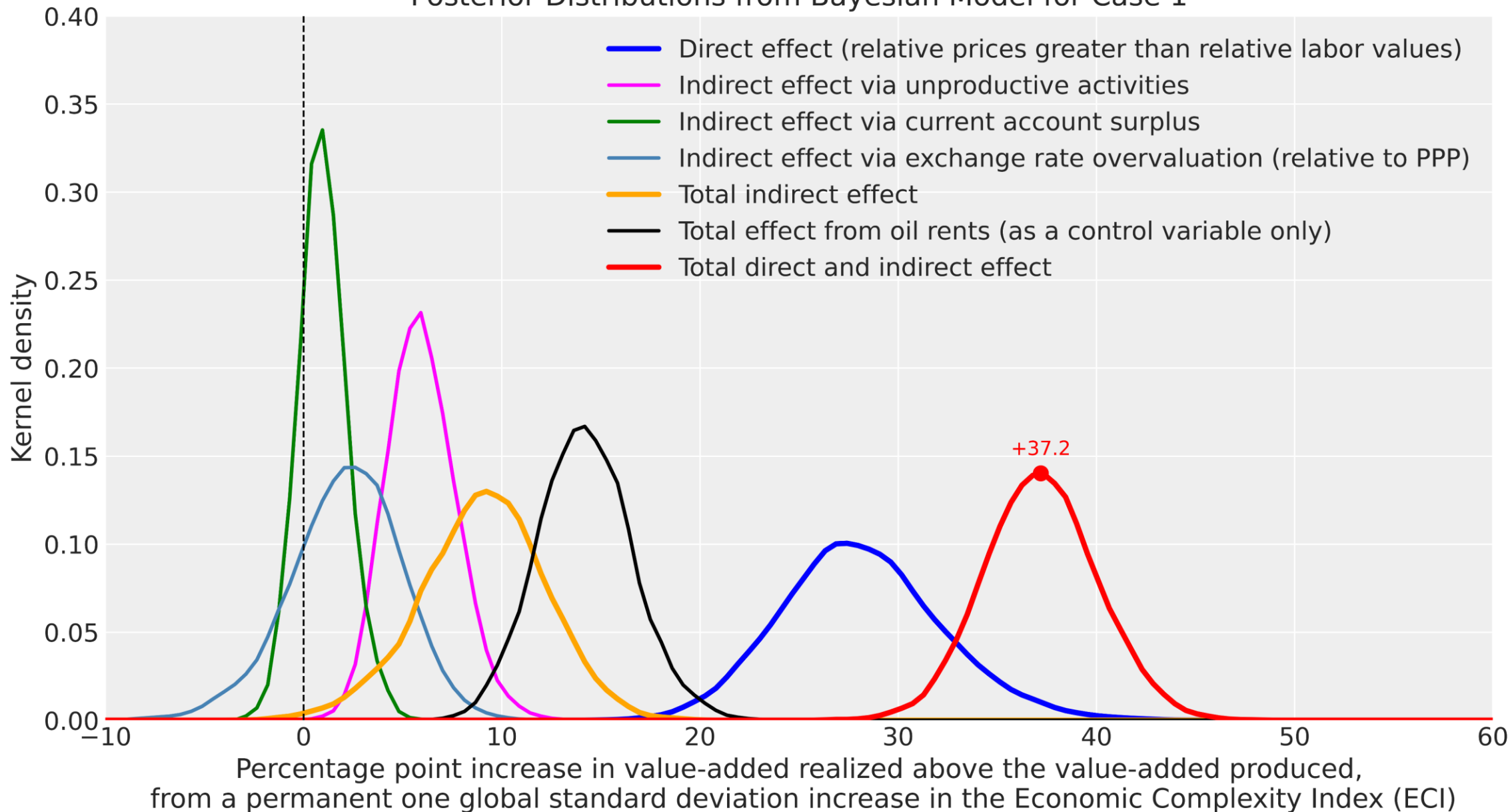
UA, RER, CA: intermediate variables

VA: fastest variable

Oil: exogenous



Long-Run Effect of Economic Complexity on Value-Added Capture (1995-2021):
Posterior Distributions from Bayesian Model for Case 1



Summary

Summary

Global economy maintains a **core-periphery** structure

This structure has become more relevant across **industries** than across **countries**

Core

Capital intensive

Lower labor exploitation

Higher complexity

Overvalued currencies

Output prices $>$ labor values

Value-added capturer

Extracts complexity rents

Greater share of unproductive activities

Periphery

Labor intensive

Higher labor exploitation

Lower complexity

Undervalued currencies

Output prices $<$ labor values

Value-added giver

Pays complexity rents to the core

Greater share of productive activities

Summary

The **unequal exchange of labor** is very substantial:

Most value **production** takes place in the **periphery**

Value **realization** is concentrated in the **core**

Value-added is transferred from high-exploitation to low-exploitation activities

SNA and GDP rely only on value-added **realized**

SNA and GDP attribute to the core the value-added **produced** in the periphery

Unequal exchange conceals the fact that a significant share of the value-added **realized** in the core was **produced** in the periphery

Summary

Complexity rents

The outputs of the **periphery** are inputs to the **core**

The outputs of the **core** are inputs to the **periphery**

Complexity enables market power within global value chains

Higher economic complexity in the **core** entails:

Monopoly pricing: **outputs** are priced above their embodied labor content

Monopsony pricing: **inputs** are priced below their embodied labor content

Hinders equalization of economic development

GDP per capita will not equalize → **Uneven economic development**

Global economy becomes much more **unequal**

Induces **labor migration** from periphery to core

Thank you

Slides available at

tomasrotta.com