Preliminary Findings | Suggestions Appreciated

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# Measuring Regional Specialization in China's Counties: An Upstreamness Perspective

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**July 2025, IIOA**

# Motivation

- Production fragmentation & specialization
  - Drive complex division of labor within production networks
- Unequal Gains Across Stages
  - Different countries or regions at different stages capture varying value-added
  - → Raises questions about ***Economic Efficiency*** vs. ***Inequality***

# Motivation

- Measuring a region's position within the network is essential to analyze its impact!

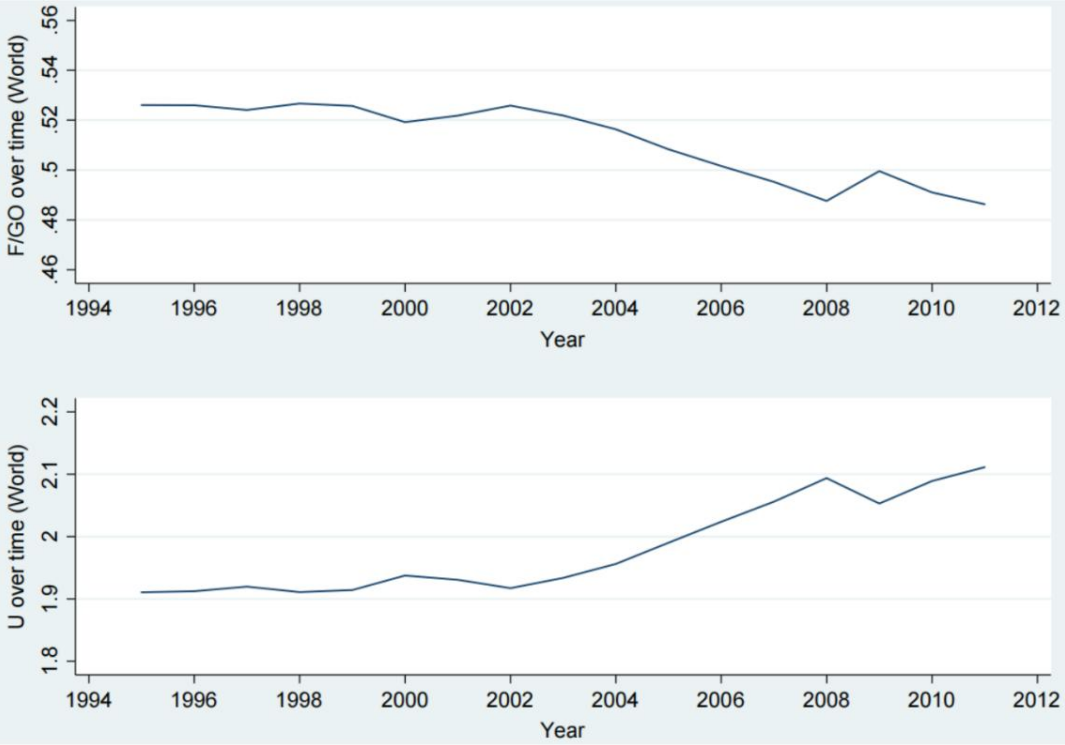



Figure 2: GVC Positioning over Time (World Average)

Source: Antràs and Chor(2018)

**Table 2**
**Evolution of GVC Measures within Country-Industries over Time**

| Dependent variable: | $F/GO_{j,t}^{s}$ (1) | $F/GO_{j,t}^{s}$ (2) | $VA/GO_{j,t}^{s}$ (3) | $VA/GO_{j,t}^{s}$ (4) | $(U)_{j,t}^{s}$ (5) | $(U)_{j,t}^{s}$ (6) | $(D)_{j,t}^{s}$ (7) | $(D)_{j,t}^{s}$ (8) |
|---|---|---|---|---|---|---|---|---|
| Year | -0.0009* | | -0.0017*** | | 0.0064*** | | 0.0084*** | |
| | [0.0004] | | [0.0005] | | [0.0015] | | [0.0017] | |
| (Dum: Year=1996) | | -0.0002 | | -0.0012 | | -0.0060 | | 0.0019 |
| | | [0.0025] | | [0.0026] | | [0.0083] | | [0.0079] |
| (Dum: Year=1997) | | -0.0015 | | -0.0024 | | 0.0026 | | 0.0061 |
| | | [0.0020] | | [0.0020] | | [0.0068] | | [0.0062] |
| (Dum: Year=1998) | | 0.0026** | | 0.0002 | | -0.0129*** | | -0.0085* |
| | | [0.0010] | | [0.0015] | | [0.0032] | | [0.0043] |
| (Dum: Year=1999) | | 0.0029*** | | -0.0005 | | -0.0086*** | | -0.0073*** |
| | | [0.0004] | | [0.0005] | | [0.0010] | | [0.0025] |
| (Dum: Year=2000) | | -0.0015 | | -0.0094*** | | 0.0140*** | | 0.0311*** |
| | | [0.0014] | | [0.0016] | | [0.0045] | | [0.0044] |
| (Dum: Year=2001) | | -0.0022 | | -0.0122*** | | 0.0182** | | 0.0394*** |
| | | [0.0020] | | [0.0021] | | [0.0065] | | [0.0053] |
| (Dum: Year=2002) | | -0.0010 | | -0.0091*** | | 0.0069 | | 0.0218*** |
| | | [0.0024] | | [0.0022] | | [0.0069] | | [0.0054] |
| (Dum: Year=2003) | | -0.0033 | | -0.0102*** | | 0.0204** | | 0.0334*** |
| | | [0.0027] | | [0.0022] | | [0.0082] | | [0.0059] |
| (Dum: Year=2004) | | -0.0052 | | -0.0135*** | | 0.0346*** | | 0.0490*** |
| | | [0.0030] | | [0.0025] | | [0.0100] | | [0.0079] |
| (Dum: Year=2005) | | -0.0061* | | -0.0153*** | | 0.0421*** | | 0.0657*** |
| | | [0.0031] | | [0.0032] | | [0.0099] | | [0.0101] |
| (Dum: Year=2006) | | -0.0084** | | -0.0208*** | | 0.0598*** | | 0.0919*** |
| | | [0.0033] | | [0.0036] | | [0.0117] | | [0.0115] |
| (Dum: Year=2007) | | -0.0119*** | | -0.0237*** | | 0.0797*** | | 0.1103*** |
| | | [0.0038] | | [0.0039] | | [0.0137] | | [0.0133] |
| (Dum: Year=2008) | | -0.0130*** | | -0.0287*** | | 0.0894*** | | 0.1333*** |
| | | [0.0044] | | [0.0048] | | [0.0159] | | [0.0154] |
| (Dum: Year=2009) | | -0.0075 | | -0.0164*** | | 0.0562*** | | 0.0746*** |
| | | [0.0052] | | [0.0052] | | [0.0171] | | [0.0150] |
| (Dum: Year=2010) | | -0.0102* | | -0.0211*** | | 0.0738*** | | 0.1027*** |
| | | [0.0055] | | [0.0053] | | [0.0180] | | [0.0167] |
| (Dum: Year=2011) | | -0.0111* | | -0.0226*** | | 0.0822*** | | 0.1110*** |
| | | [0.0055] | | [0.0054] | | [0.0179] | | [0.0168] |
| Country-Industry FE? | Y | Y | Y | Y | Y | Y | Y | Y |
| Observations | 24,076 | 24,076 | 24,395 | 24,395 | 24,395 | 24,395 | 24,395 | 24,395 |
| $R^2$ | 0.9709 | 0.9709 | 0.9491 | 0.9495 | 0.9632 | 0.9636 | 0.9444 | 0.9460 |

# Motivation

- The Gap: Intra-National Focus
  - Limited research exists on division of labor between regions ***within*** a single country
  - Regions possess distinct ***comparative advantages*** (including natural resources, industrial base, technical capability…)
  - China: Vast territory and Significant regional economic disparities

# Related Literature

- **Global Production Patterns and Globalization:** Yeats (1997); Jones & Kierzkowski (1990); Hummels et al. (2001); Baldwin (2009); Koopman et al. (2012)
  - **Economic Gains from Global Division of Labor:** Liu et al. (2010); Tajoli & Felice (2018); Chor et al. (2021) ; Song et al. (2021); Borin et al. (2021)
  - **Inequality Effects:** Basco & Mestieri (2019); Baldwin et al. (2021); Han & Liu (2024)
  - **The Smile Curve:** Meng et al.(2015); Baldwin & Ito (2021); Stöllinger (2021); Antreoni & Anzolin (2025)
- **Quantifying Positions in Global Value Chain**
  - **APL:** Dietzenbacher & Romero (2005, 2007); Inomata (2008); Fally (2012); Ni et al. (2016); Wang et al. (2017); Chen (2018)
  - **Upstreamness:** Antràs et al. (2012); Fally (2012); Suganuma (2016); Miller & Temurshoev (2017); Aroca & Jackson (2018); Antràs et al. (2018)
- **Extensions of Upstreamness**
  - **Industry and Economic Shock:** Aroca & Jackson (2018); Li (2018); Suganuma (2016); Yang (2024)
  - **Applications at Regional and Firm Level:** Lukin (2019); Chor et al. (2021)

# Research Questions

1. **Measurement:** How to compute county-level upstreamness by weighting national industry upstreamness with output shares?
2. **Dynamics:** What are the temporal and spatial evolution patterns of upstreamness across Chinese counties?
3. **How does regional division of labor affect intra-regional disparities?**
   - **Determinants & Impacts :** What's the relationship between cross-county different positions and some socio-economic factors?
   - How does a nation's internal division of labor positioning shape regional economic development levels and value distribution?

# Upstreamness : From Industry to County

County-level Upstreamness

- The Best Choice: County-level IO Tables
- The Method we use: the product of the industry's national upstreamness and its share of the county's total output

$$U_k = \sum_i U_i \cdot \frac{P_{ki}}{P_k}$$

# Conceptual Framework: How to Calculate Upstreamness?

- "A weighted average of the distances of intermediate products to final demand production"
- Step 1: Decomposition of total output

$$Y_i = F_i + \sum_{j=1}^{N} d_{ij}F_j + \sum_{j=1}^{N}\sum_{k=1}^{N} d_{ik}\,d_{kj}F_j + \sum_{j=1}^{N}\sum_{k=1}^{N}\sum_{l=1}^{N} d_{il}\,d_{lk}\,d_{kj}F_j + \cdots$$

- Step 2: Calculation of upstreamness (Antràs et al., 2012)

$$U_i = 1 \times \frac{F_i}{Y_i} + 2 \times \frac{\sum_{j=1}^{N} d_{ij}F_j}{Y_i} + 3 \times \frac{\sum_{j=1}^{N}\sum_{k=1}^{N} d_{ik}\,d_{kj}F_j}{Y_i} + 4 \times \frac{\sum_{j=1}^{N}\sum_{k=1}^{N}\sum_{l=1}^{N} d_{il}\,d_{lk}\,d_{kj}F_j}{Y_i} + \cdots$$

- Step 3: Simplification $U = [I - \Delta]^{-1}u$

# Conceptual Framework: Upstreamness in open economy

In reality: Trade with other countries

- Step 1: Decomposition of  total output (considering Exports and Imports)

$$Y_i = F_i + \sum_{j=1}^{N} d_{ij} Y_j + X_i - M_i$$

- Step 2: Adjusted input coefficient: $\hat{d}_{ij} = d_{ij} \cdot \frac{Y_i}{Y_i - X_i + M_i}$

- Step 3: Calculation (Simplified)

$$U = \left[ I - \hat{\Delta} \right]^{-1} u$$

# Upstreamness : From Industry to County

- The Method we use: the product of the industry's national upstreamness and its share of the county's total output
- **Why it works?**
  - Assumption: the division of labor for the same industry across regions is similar, with no significant differences in upstreamness
  - It's reasonable： The clearer the definition, the more similar it is across regions

(Industry classification in IO tables: 122 to 149 sectors)

# Upstreamness : From Industry to County

- The Method we use: the product of the industry's national upstreamness and its share of the county's total output
- **How to get each industry's output share?**
  - According to micro-level enterprise database (ASIF and ATS）
  - Aggregating enterprise-level total output to derive industry-level output share

# Data Sources

- National Input-Output Tables (benchmark years:1997, 2002, 2007, 2012, 2017)
  - Used to compute industry-level upstreamness
- China Annual Survey of Industrial Firms (1998–2014)
  - includes all state-owned and large non-state-owned industrial enterprises in China from 1998 to 2014, totaling over 4.35 million observations across 16 years
  - Microdata on firm output, location, and industry classification
- National Tax Survey Database (2007–2020)
  - Supplementary firm-level data covering smaller enterprises
- County-Level Statistical Yearbooks (2000–2015)
  - Socioeconomic indicators for counties

# Data Sources

Representative Micro-level Database:

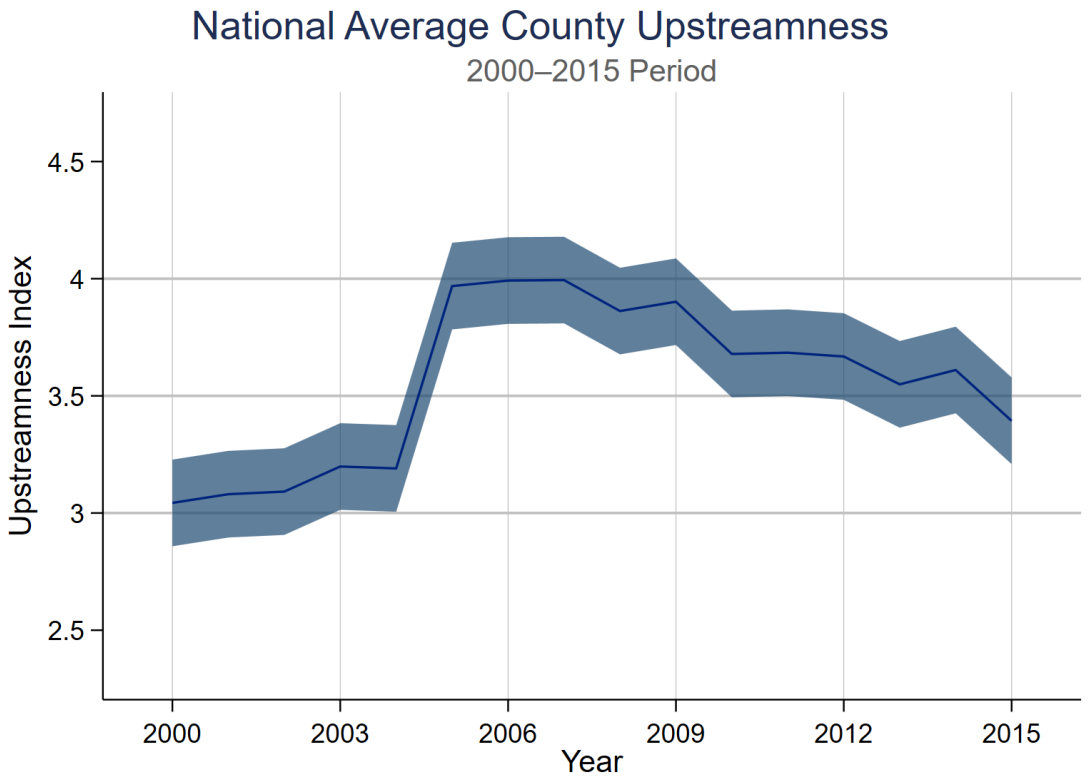
- China Annual Survey of Industrial Firms (1998–2014)

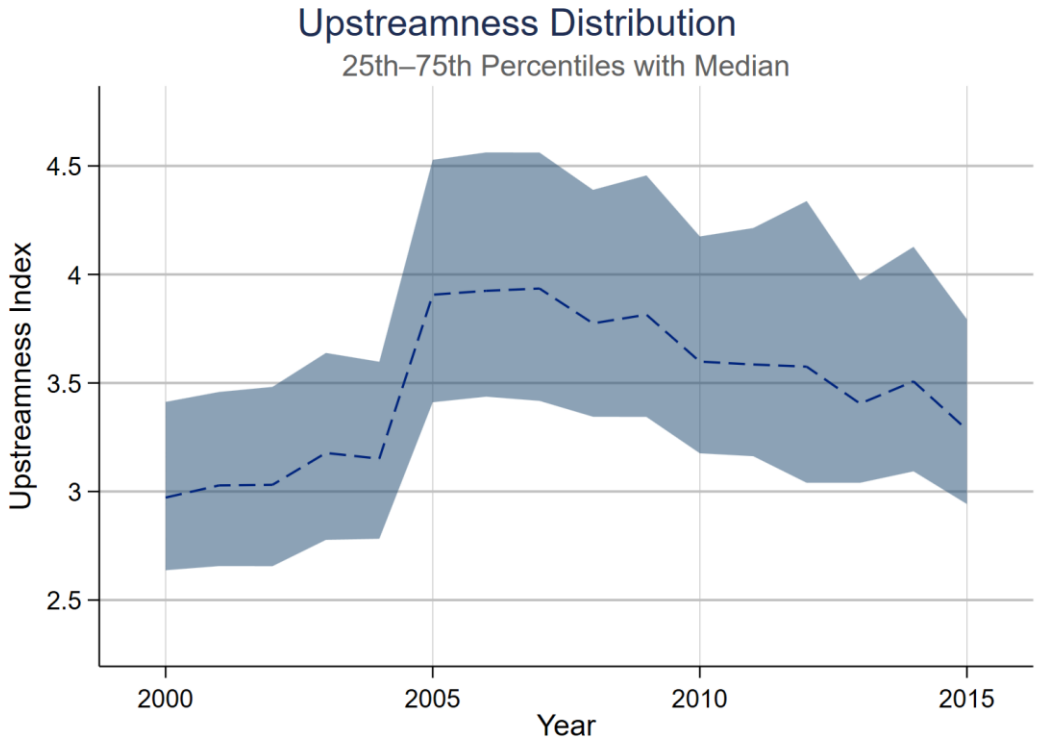
| Year | Number of Observations | Total Output (Billion Yuan) | Proportion of Industrial Sector Output |
|---|---|---|---|
| 2002 | 181,557 | 11077.65 | 78.58% |
| 2007 | 336,768 | 40514.29 | 90.53% |
| 2012 | 308,863 | 81137.66 | 99.61% |

- National Tax Survey Database (2007–2020)

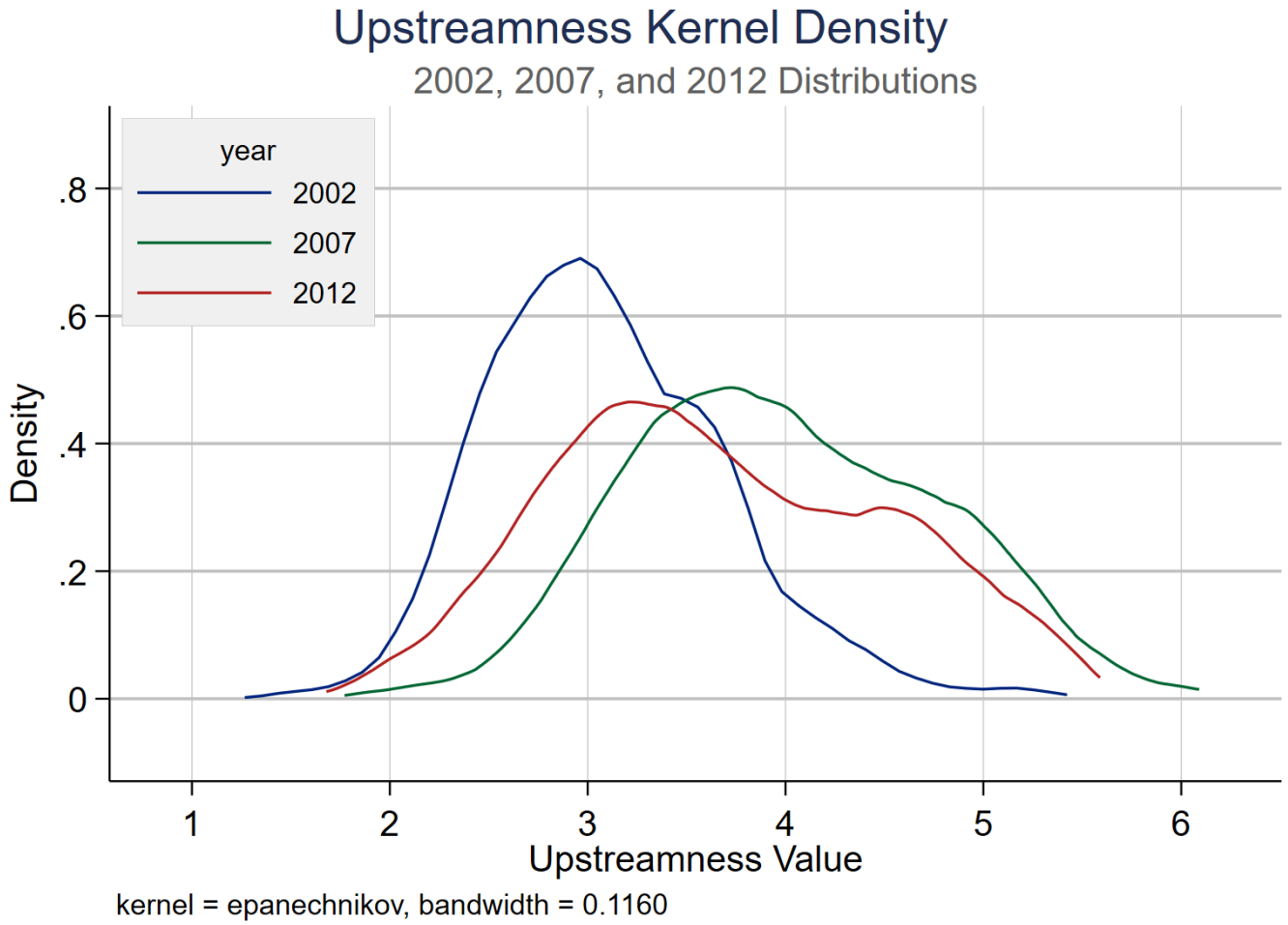
| Year | Number of Observations | Total Output (Billion Yuan) | Proportion of Total Industry Output |
|---|---|---|---|
| 2007 | 313,051 | 43283.232 | 52.86% |
| 2012 | 696,761 | 27520.581 | 38.01% |

# Stylized Facts: Time Trends

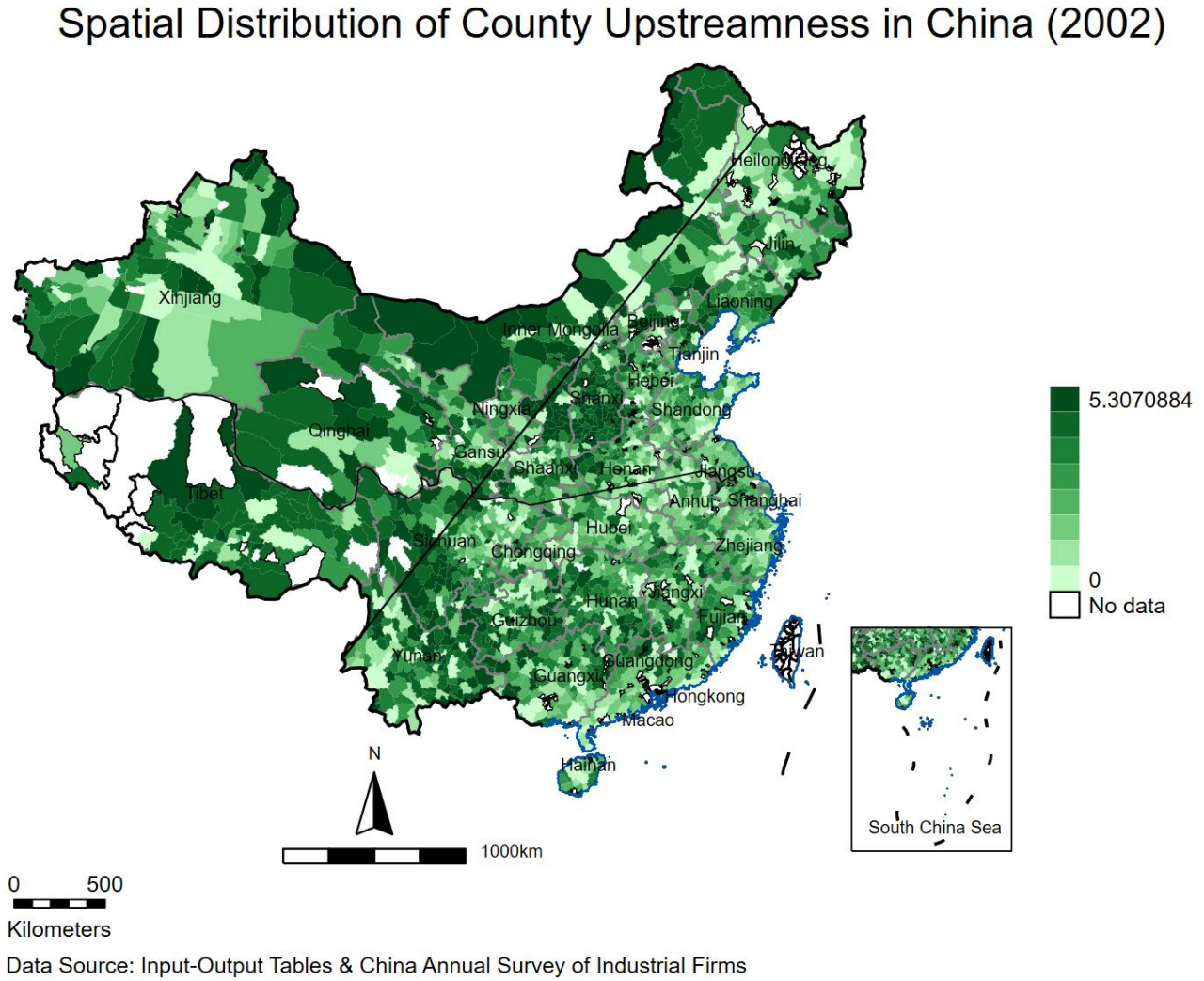


# Stylized Facts: Time Trends



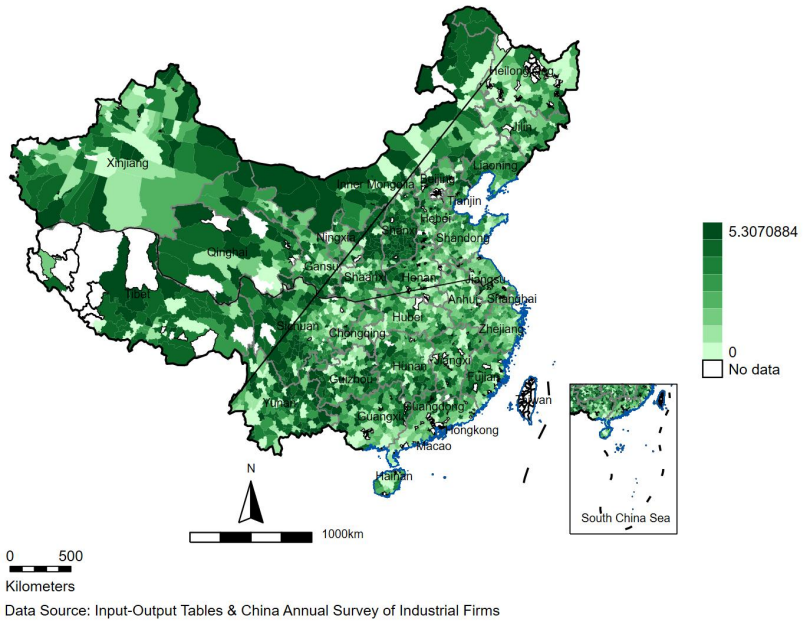
# Stylized Facts: Spatial Distribution




Data Source: Input-Output Tables & China Annual Survey of Industrial Firms

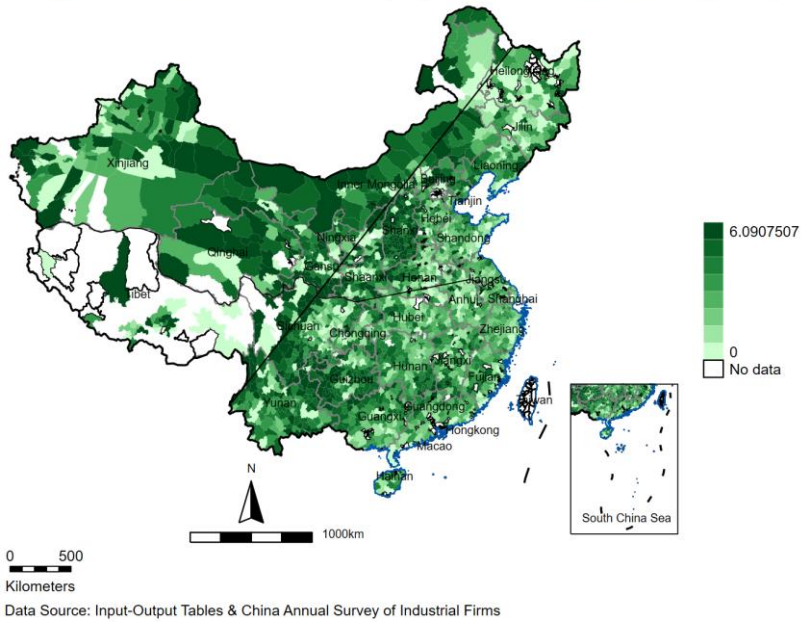
# Stylized Facts: Spatial Distribution

Spatial Distribution of County Upstreamness in China (2002)



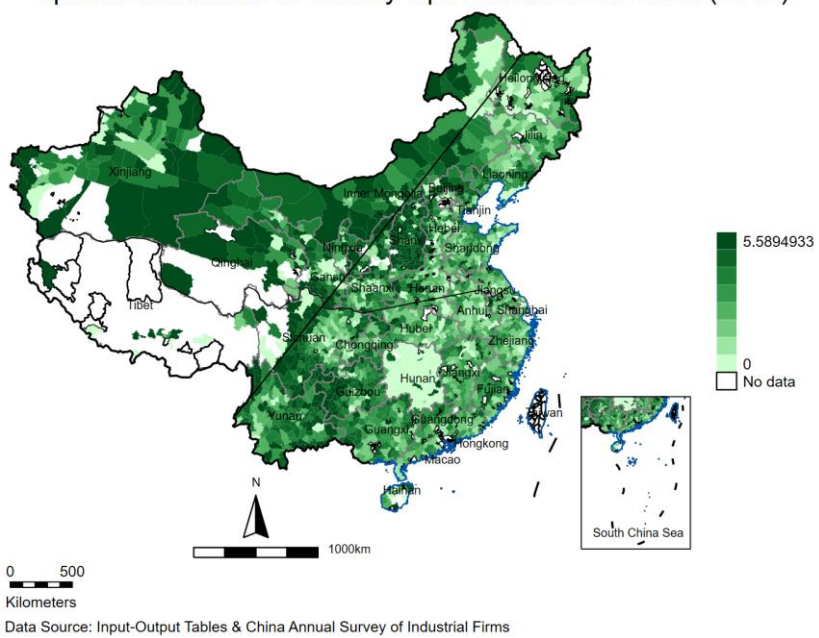

Data Source: Input-Output Tables & China Annual Survey of Industrial Firms

Spatial Distribution of County Upstreamness in China (2007)



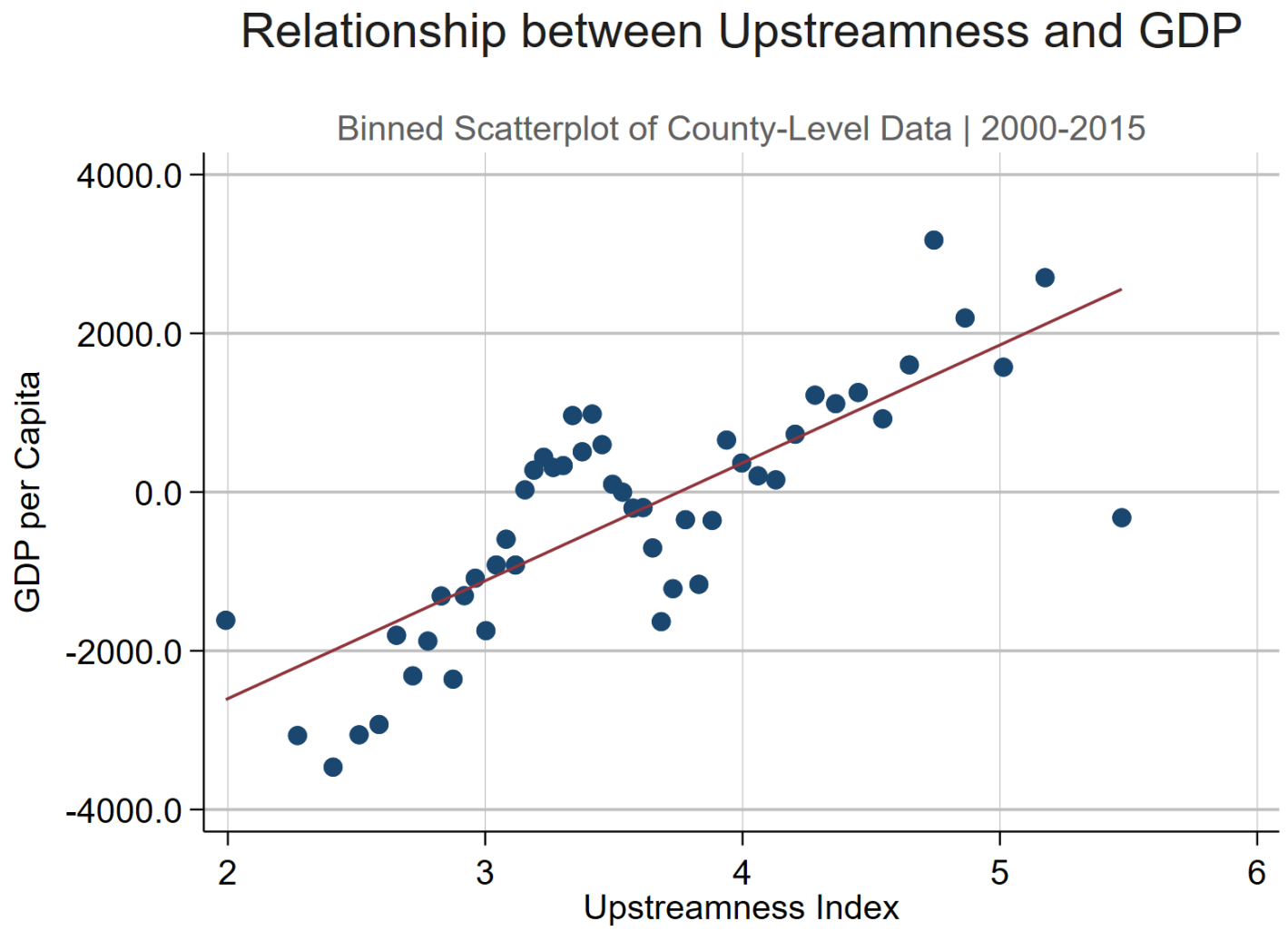

Data Source: Input-Output Tables & China Annual Survey of Industrial Firms

Spatial Distribution of County Upstreamness in China (2012)

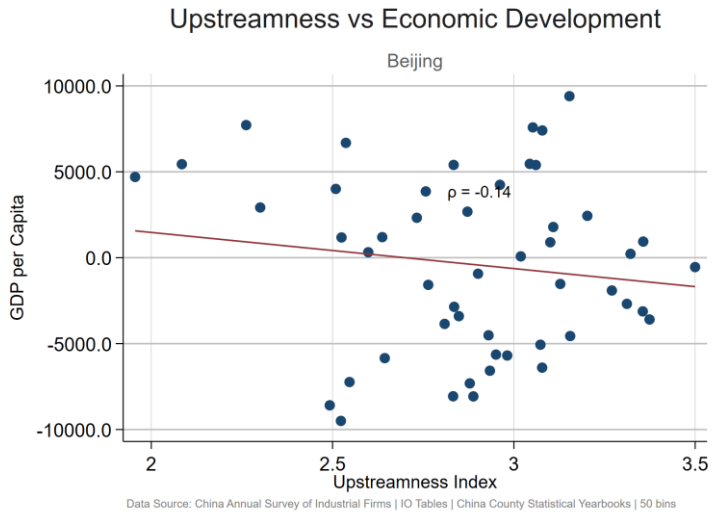


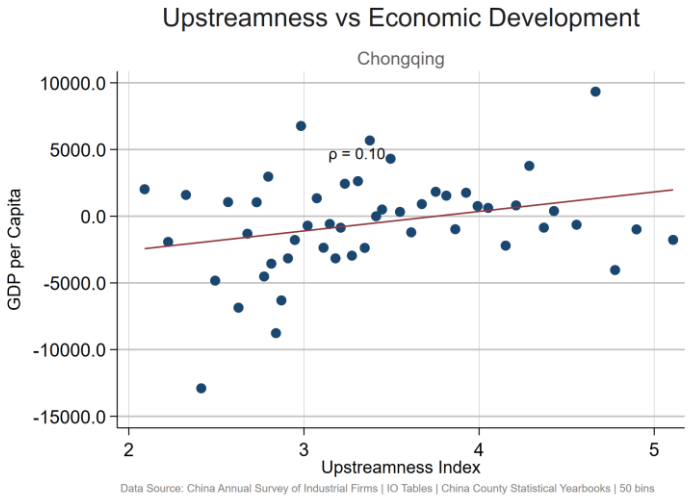

Data Source: Input-Output Tables & China Annual Survey of Industrial Firms

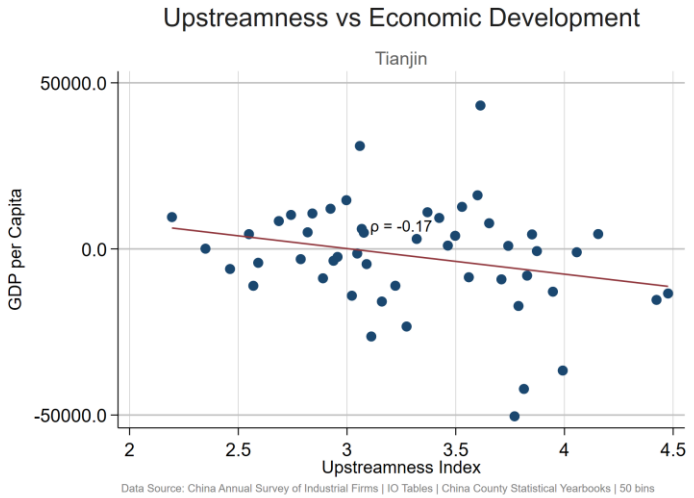
# Correlation with GDP per capita

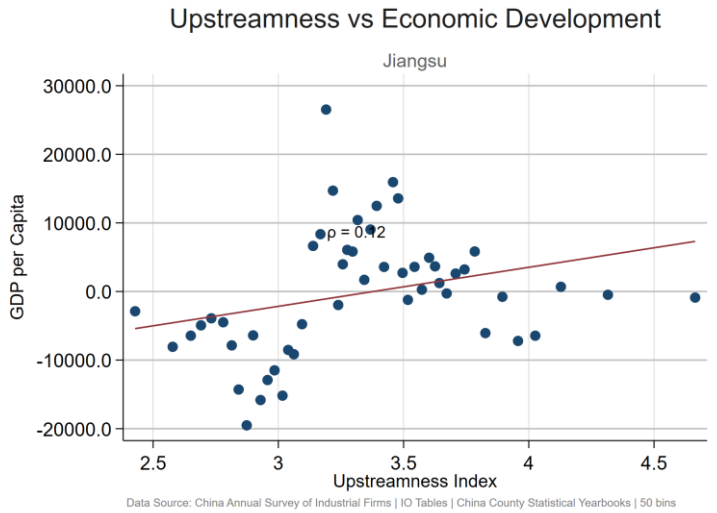


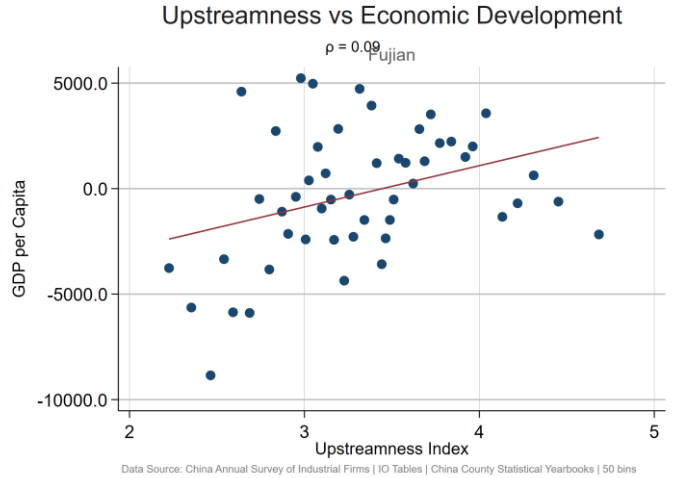
# Correlation– More developed Provinces

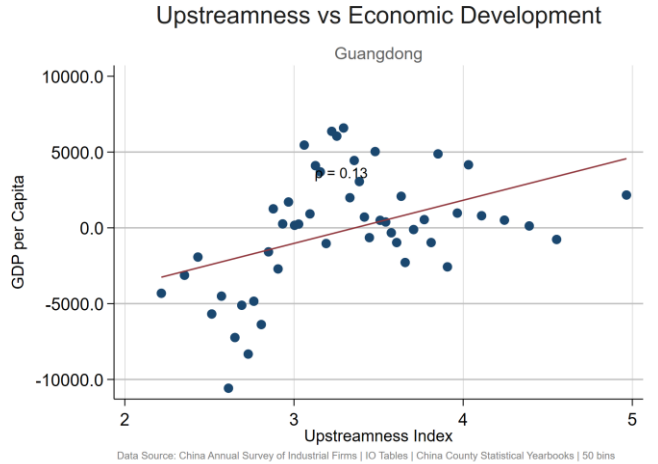


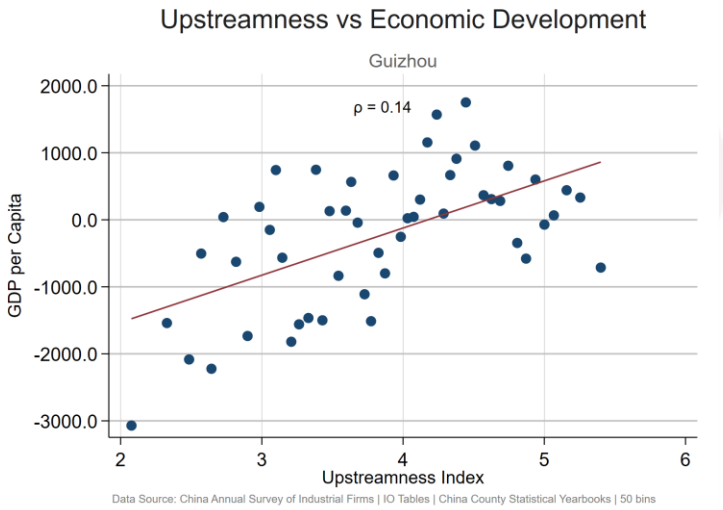



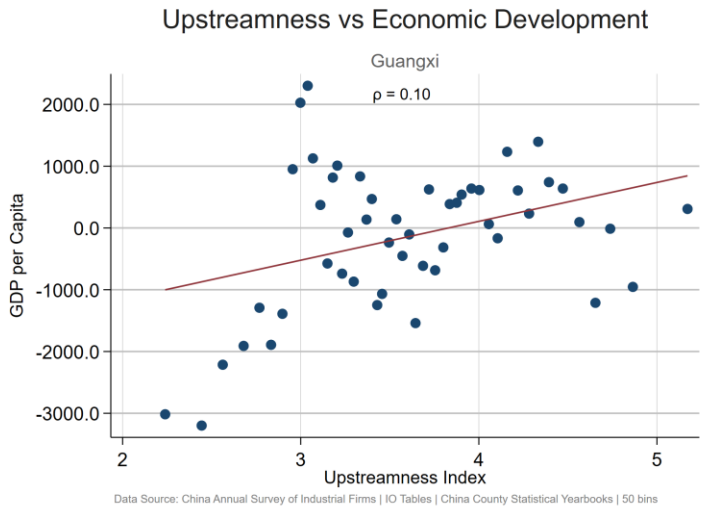



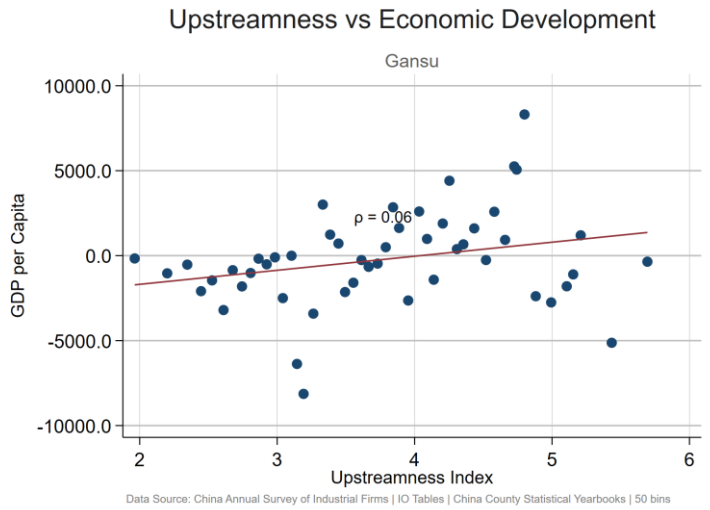



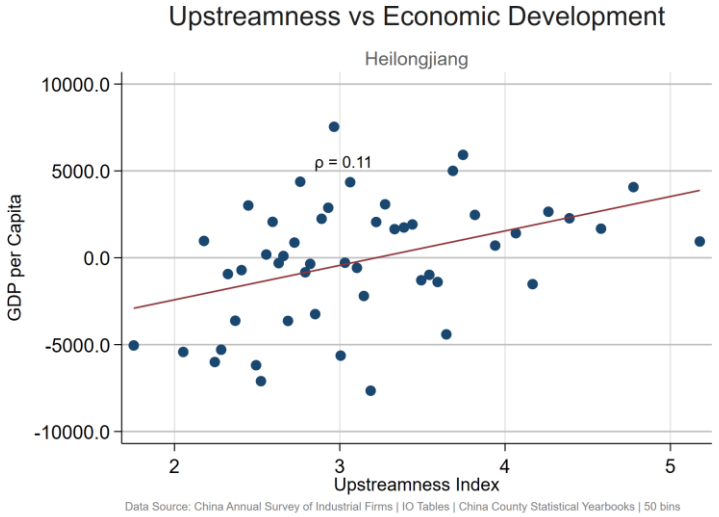



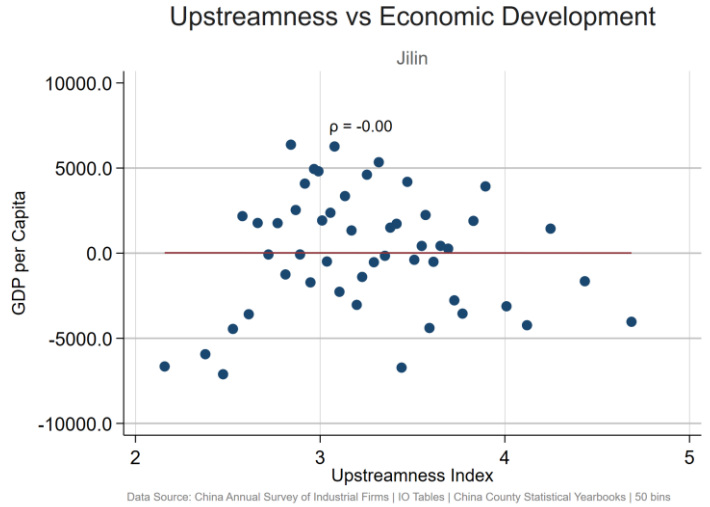
# Correlation– Less developed Provinces

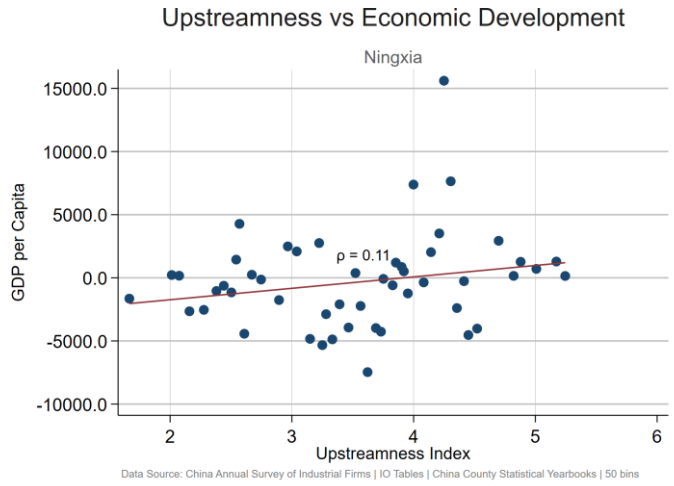


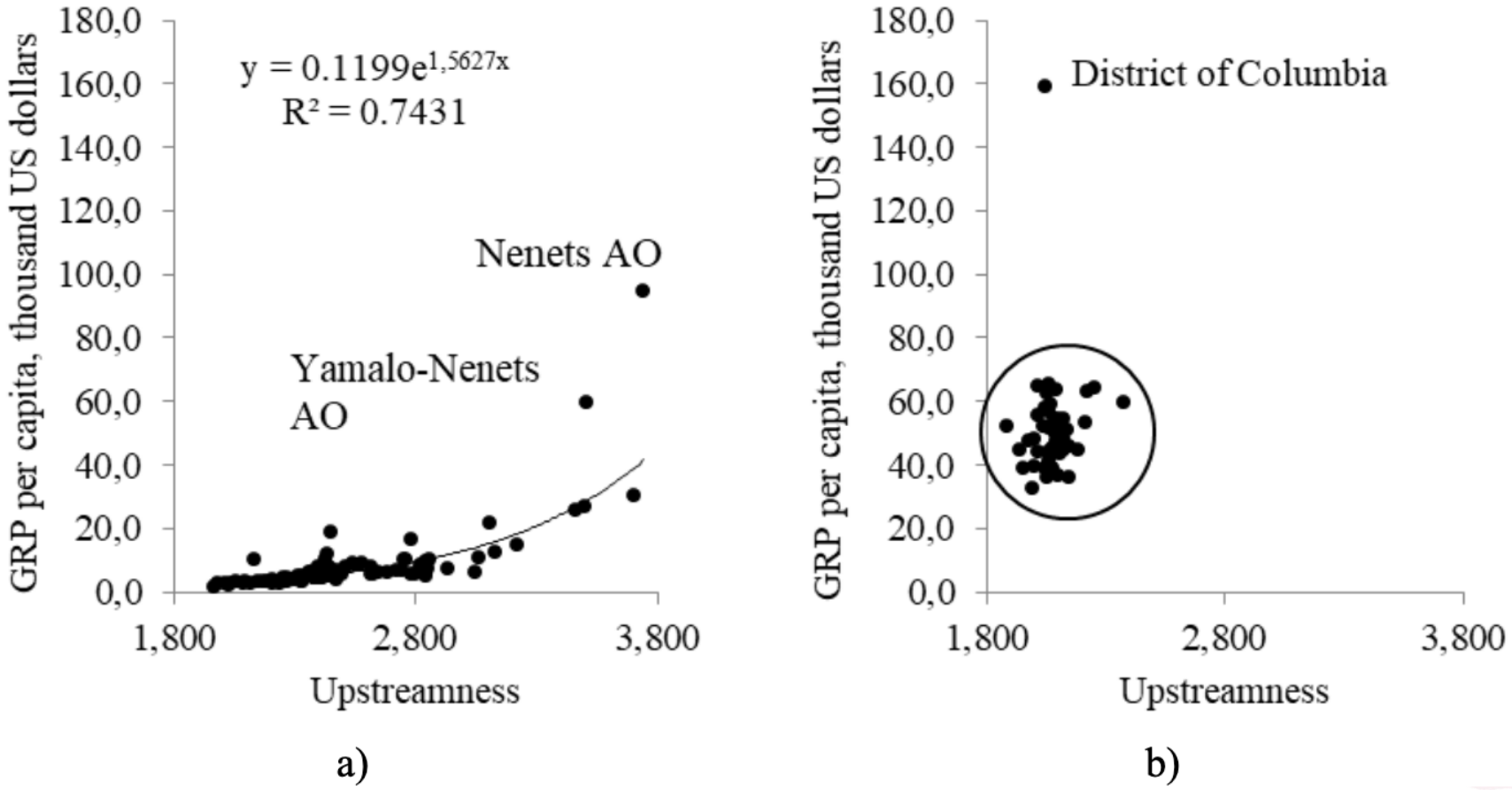



# Correlation with GDP per capita: Other cases

**Figure 3: Correlation between GRP per capita and an upstreamness indicator for economies of regions in Russia (a) and the USA (b) in 2015**




Source: Lukin (2019)

# Conclusions

## Temporal Shift

- National upstreamness ↑ sharply → complexified production
- County-level distribution → wider dispersion (kernel density)

## Spatial Pattern

- High-upstreamness clusters: West of Hu Line & SW China
- Resource-based regions align with expectations

- Economic Impact
  - Overall: Per capita GDP ⇧ Upstreamness
  - Within provinces (poor/wealthy): No uniform correlation
  - → Strong inter-provincial trade & specialization
  - → Diverges from national trend

# Discussion

- Research Objective: How does intra-national division of labor positioning shape:

  Regional economic development & Value distribution patterns

→Scrutinizes the "Smiling Curve" theory

→Novel lens for inter-regional income disparities

- How to explain divergent upstreamness patterns: China vs. Russia vs. US?
  - Industrial Upstreamness vs. Economy-wide Upstreamness
- Next-Phase Research Framework
  - Methodology:Regional input-output analysis
  - Considering domestic trade cost integration

# The End

Thanks for listening

# Conceptual Framework: What is Upstreamness?

- Upstreamness quantifies **how far** an industry is, on average, from final demand in the production process
- Upstreamness is an indicator that
  - Measures an economic entity's ***position*** in the production chain
  - Represents its ***dependence on earlier stages*** of production
- Economic Intuition
  - An industry that sells most of its output directly to final consumers (e.g., retail, food services) has ***low upstreamness*** (close to 1)
  - An industry that sells primarily to other industries (e.g., mining, basic chemicals) has ***high upstreamness***