Economic Integration and Structural Change

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Main Questions

- What characterizes structural change?
  - i.e. how does the allocation of resources to different economic sectors change with development?
  - This is a classic question in economics, going back at least to Kuznets (1966)
- What determines structural change?
  - What forces affect changes in sectoral structure?
  - Also a classic question (Chenery, Robinson and Syrquin, 1984)
- These issues are of renewed policy relevance:
  - Effect of China's emergence on US and EU manufacturing employment
  - Renewed calls for an "industrial policy" in developing countries
  - Importance of economic diversification for macro shocks propagation
- We have very few facts, and even fewer explanations for these few facts

One Robust Fact We Do Have

- Countries go through stages of diversification
  - Imbs and Wacziarg (2003).
- We don't really know why.

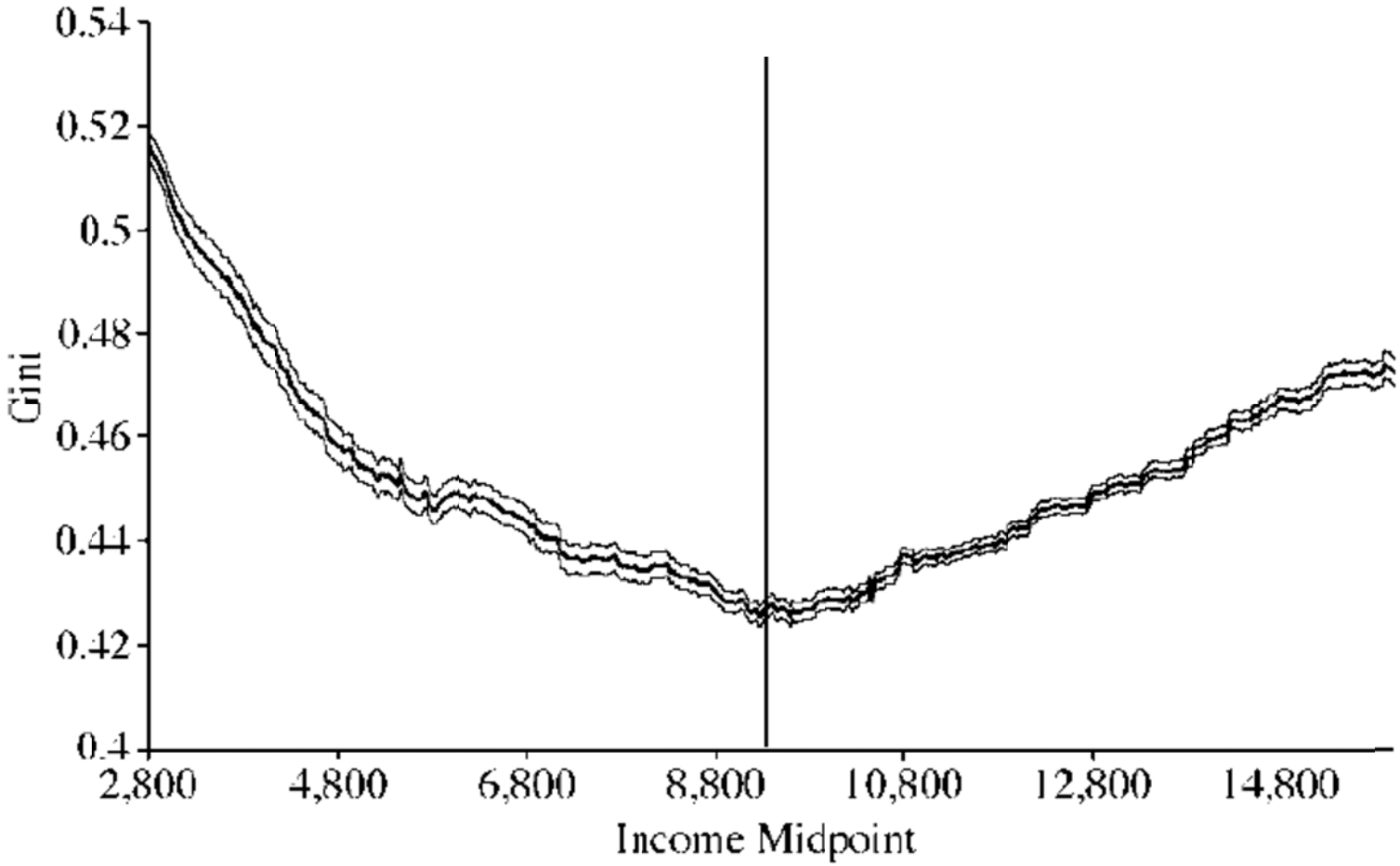


FIGURE 1. ESTIMATED CURVE (NONPARAMETRIC)—GINI INDEX—ILO 1-DIGIT EMPLOYMENT DATA

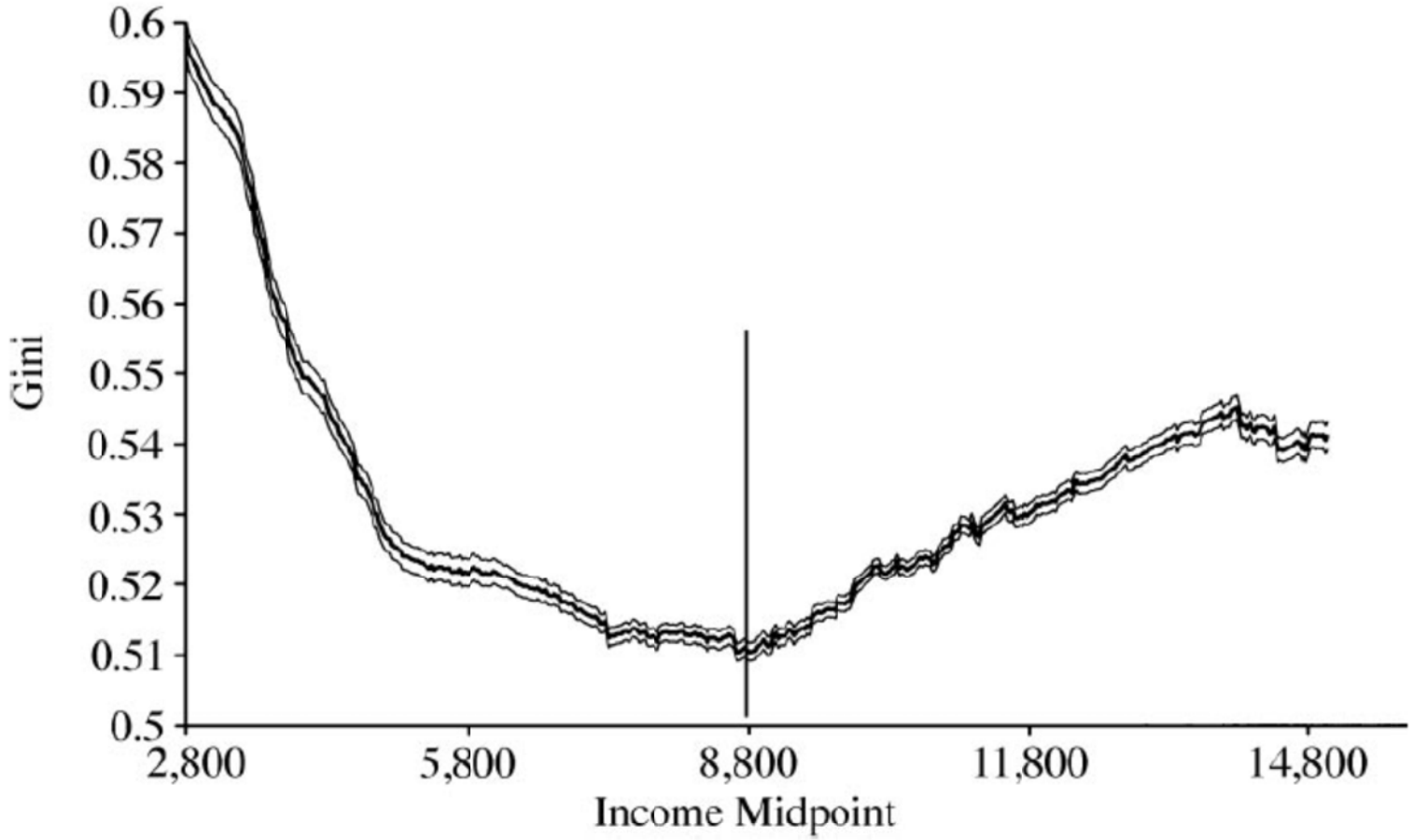


FIGURE 2. ESTIMATED CURVE (NONPARAMETRIC)—GINI INDEX—UNIDO 3-DIGIT EMPLOYMENT DATA

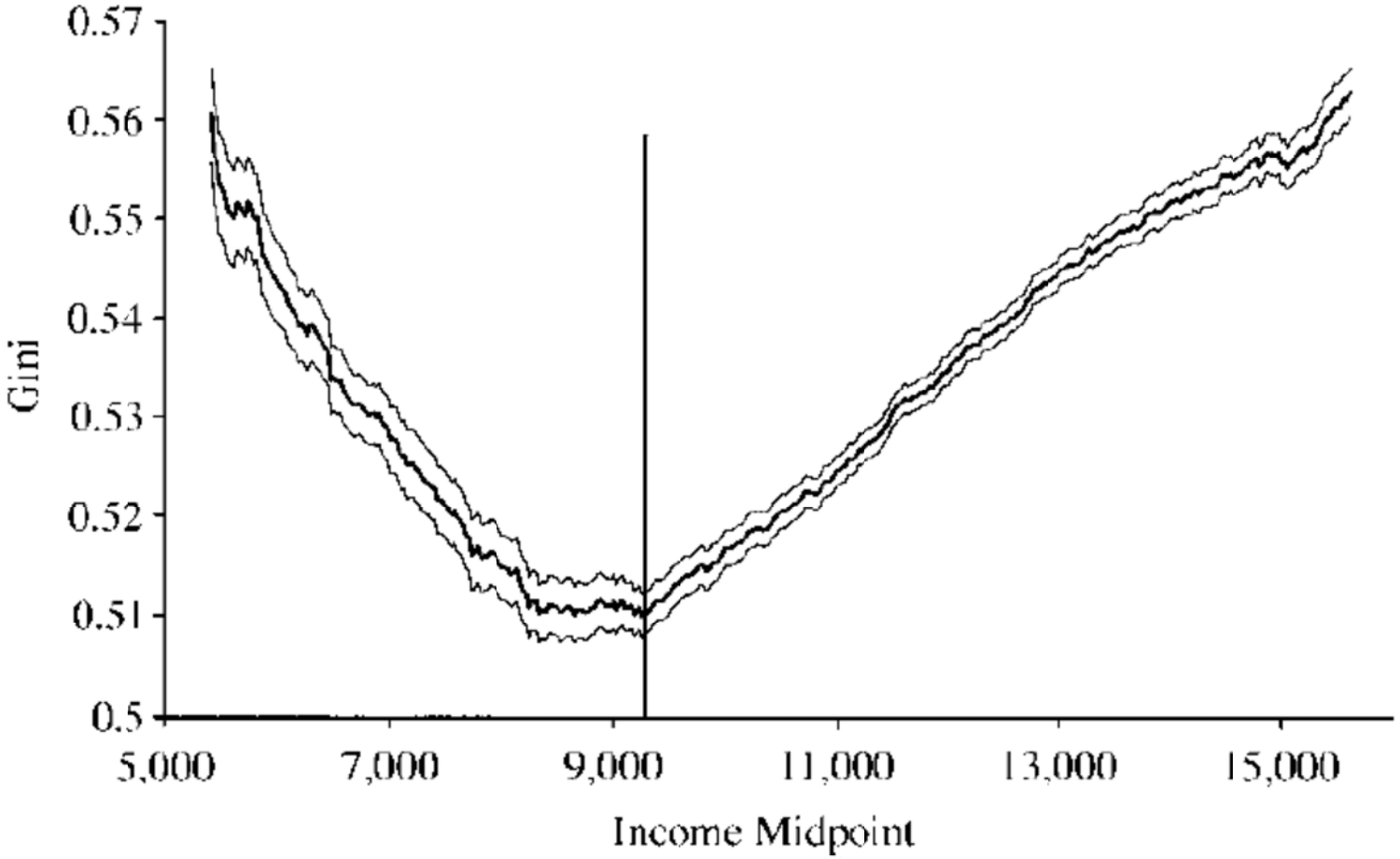


FIGURE 7. ESTIMATED CURVE (NONPARAMETRIC)—GINI INDEX—OECD 2-DIGIT EMPLOYMENT DATA

Starting point for this paper

- The specialization / diversification of economic activity is the outcome of economic integration
- Structural change reflects two dimensions of economic integration: local (intranational) vs. global (international) integration.
- Integration has a local component - usually overlooked.
- Structural change is the result of *both* local and global economic integration. The local dimension is key.

What We Find

- Sectoral diversification in early stages of development is accompanied by geographic agglomeration and structural divergence.
- The range of activities expands and factors are allocated increasingly equally across sectors (diversification). New sectors localize in specific, agglomerated regions (agglomeration). Regions become increasingly different in terms of what they produce (divergence).

- Sectoral concentration in later stages of development is accompanied by geographic dis-agglomeration and structural convergence.
- The reduced range of activities (specialization) is produced across all regions (dis-agglomeration). The location of activity does not seem to matter as much. Regions become increasingly similar (convergence).

How We Interpret These Findings

- Low income countries tend to be autarkic. Regions that form the country tend to themselves be autarkic .
- As local barriers to trade fall (roads, railroads, infrastructure), regions specialize in different activities. The country diversifies, activity agglomerates geographically, and regions become structurally different (Stage I)

- Integration proceeds to international borders (trade liberalizations, free trade areas, WTO membership, lower tariffs, infrastucture for international trade).
- The country's constituent regions tend to *all* specialize in the country's comparative advantage. Activity dis-agglomerates geographically - and the country specializes. Regions become structurally similar (Stage II)
- Areas composed of countries trading with each other (e.g. Europe) become diversified, as they are constituted of countries specialized in different activities. Activity agglomerates at country level, Trading countries diverge structurally.

Transition

- Why does international comparative advantage take over from inter-regional comparative advantage?
- In stage 2, trading regions also converge in terms of technology, income levels, factor accumulation. Comparative advantage converges across regions.
- As productivity converges between (trading) regions, international comparative advantage takes over, which leads to specialization.

How We Test This Interpretation

- Introduce three measures (specialization, agglomeration, dissimilarity), computed on unique datasets on sectoral information at sub-national level.
- European integration. High-income countries: stage I is completed. Diversified countries composed of agglomerated regions.
- With European integration, each country should go through stage II: all regions in one country should produce the same range of goods, each country should specialize, as activity dis-agglomerates and regions become similar.
- Europe *as a whole* should go through stage I: countries specialize in different activities, so that Europe diversifies as its constituent countries agglomerate.

Outline

1. Model with non-traded goods and non-trading regions (quick).
2. Measures of specialization, agglomeration, dissimilarity.
3. European results
4. Case studies of India, China and the US
5. Large sample results in developing and developed countries.

1. A simple Ricardian Model

- A simple 3*3*3 Ricardian framework with three points in time $t = 0, 1, 2$ where goods market integration implies patterns of specialization, agglomeration, dissimilarity.
- 3 major assumptions:
  - Gradual integration, first regional ($t = 1$) and later international ($t = 2$)
  - Full specialization at $t = 0$.
  - Convergence in sectoral productivity vectors across regions within countries at $t = 2$.
- Introduce non-tradable goods, and non-trading regions. Use model to draw inferences on sub-samples focused on traded goods / open regions only.

Model Predictions

	Region 1		Region 2	
Time	Sector 1	Sector 2	Sector 1	Sector 2
0 (initial)	1	0	1	0
1 (intermediate)	1	0	0	1
2 (developed)	0	1	0	1

Time	Country-level Specialization	Regional Agglomeration	Regional Dissimilarity
0 (initial)	1	0.5	0
1 (intermediate)	0.5	1	1
2 (developed)	1	0.5	0

2. Indices: Sectoral Specialization

- Simple Herfindahl index of sectoral specialization:

$$S_{it}^{H} = \sum_{s} \left(\frac{\sum_{j} Y_{ijst}}{\sum_{s} \sum_{j} Y_{ijst}} \right)^{2}$$

  country i, region j, sector s, time t. Y_{ijst} a measure of economic activity - typically employment.

- Does not require regional data - since sectors are aggregated across regions.

Indices: Regional Agglomeration

- Analogous definitions. Regional Herfindahl:

$$A_{ist}^{H} = \sum_{j} \left(\frac{Y_{ijst}}{\sum_{j} Y_{ijst}} \right)^{2}$$

  Captures the allocation of sector s across the regions j that constitute country i.

- Requires sectoral information at sub-national level. Computed sector by sector and aggregated using (time-varying) weight of sector in overall economy, $\left(\sum_{j} Y_{ijst}\right) / \left(\sum_{s} \sum_{j} Y_{ijst}\right)$.

Indices: Regional Dis-similarity

- Dissimilarity between regions is captured by an average of bilateral differences in sectoral shares. For all pairs of regions j and k in country i, compute:

$$D_{ist} = \frac{2}{J(J-1)} \sum_{j<k} \left| \frac{Y_{ijst}}{\sum_s Y_{ijst}} - \frac{Y_{ikst}}{\sum_s Y_{ikst}} \right|$$

  where J is the total number of regions in country i.

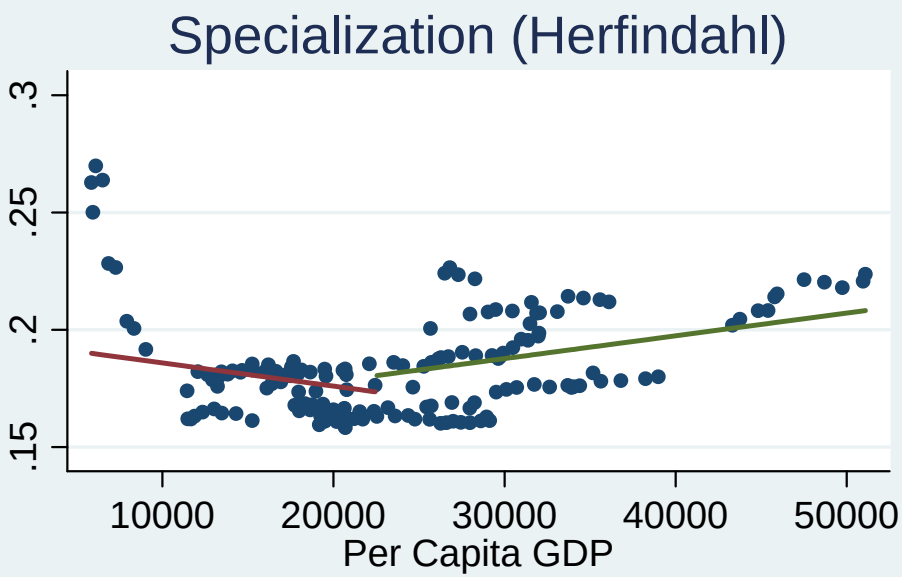
- Requires sectoral information at sub-national level. Computed sector by sector and aggregated arithmetically:

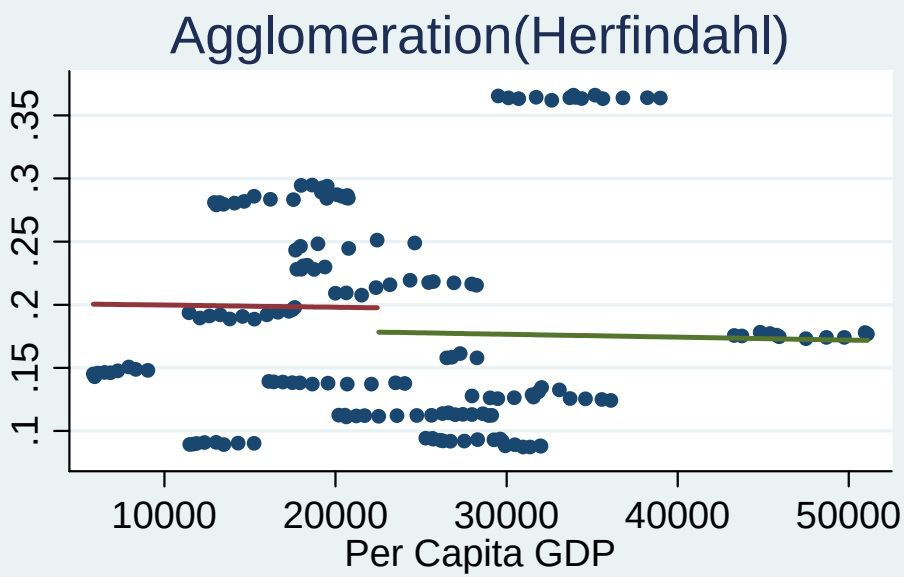
$$D_{it} = \frac{1}{S} \sum_s D_{ist}$$

3. European Evidence

- The European Statistical Agency (EUROSTAT) collects regional employment data for member and accession countries.
- Data are available for a maximum of 14 countries, at the one-digit level.
- Year coverage varies from country to country - so does the number of regions. Data are rectangular over time within each country. Estimation has country fixed effects.

Figure 1: Eurostat - 14 countries





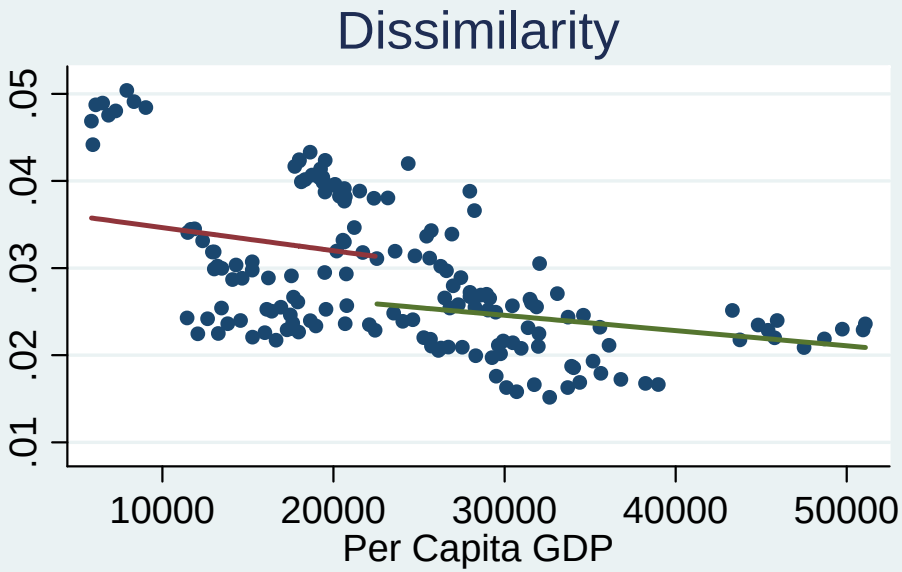


Table 1: Eurostat - Regional Data

	Specialization	Agglomeration	Dissimilarity
Low	-0.987	-0.173	-0.265^{***}
	(–1.40)	(–0.61)	(–2.76)
High	0.970^{***}	-0.229^{**}	-0.175^{**}
	(6.07)	(–2.39)	(–2.18)
Obs.	81	81	81

Notes: The Table reports coefficient estimates in a regression of a sectoral Herfindahl index on real per capita GDP estimated for "low" and "high" income sub-samples. The mid-point corresponds to median per capita GDP. The number of observations refers to each sub-sample. All estimations include country-specific fixed effects. Coefficients are multiplied by 10^6. Student's t-statistics are reported between parentheses. $^{***\,(**,*)}$ denote significance at 1% (5%, 10%) significance levels.

The European Union

- Stage II: European countries are specializing, each country's regions are dis-agglomerating and becoming similar. This happens as they integrate globally - with the rest of the Union.
- Thus, the Union as a whole should be diversifying, as its constituent countries specialize in different activities. Activity should agglomerate at country level within the Union - and countries should become dissimilar.

ILO data for European countries

- We can construct an economic area formed by integrating European countries - these are countries that integrate *with each other*.
- This exercise does not require regional data, since it is now countries that represent the integrating regions of the EU.
- Use one-digit sectoral employment from International Labor Office, on the same 14 countries.
- Data must now be rectangular for the European Union as a whole - i.e. same sectors and same year coverage.
- Final coverage includes 14 countries and 8 sectors, 1969-2008.
- EU as a whole is in stage I: agglomeration (and structural divergence) should be more pronounced if computed on samples focused on traded goods / trading regions.

Figure 2: ILO - EU 14 Countries

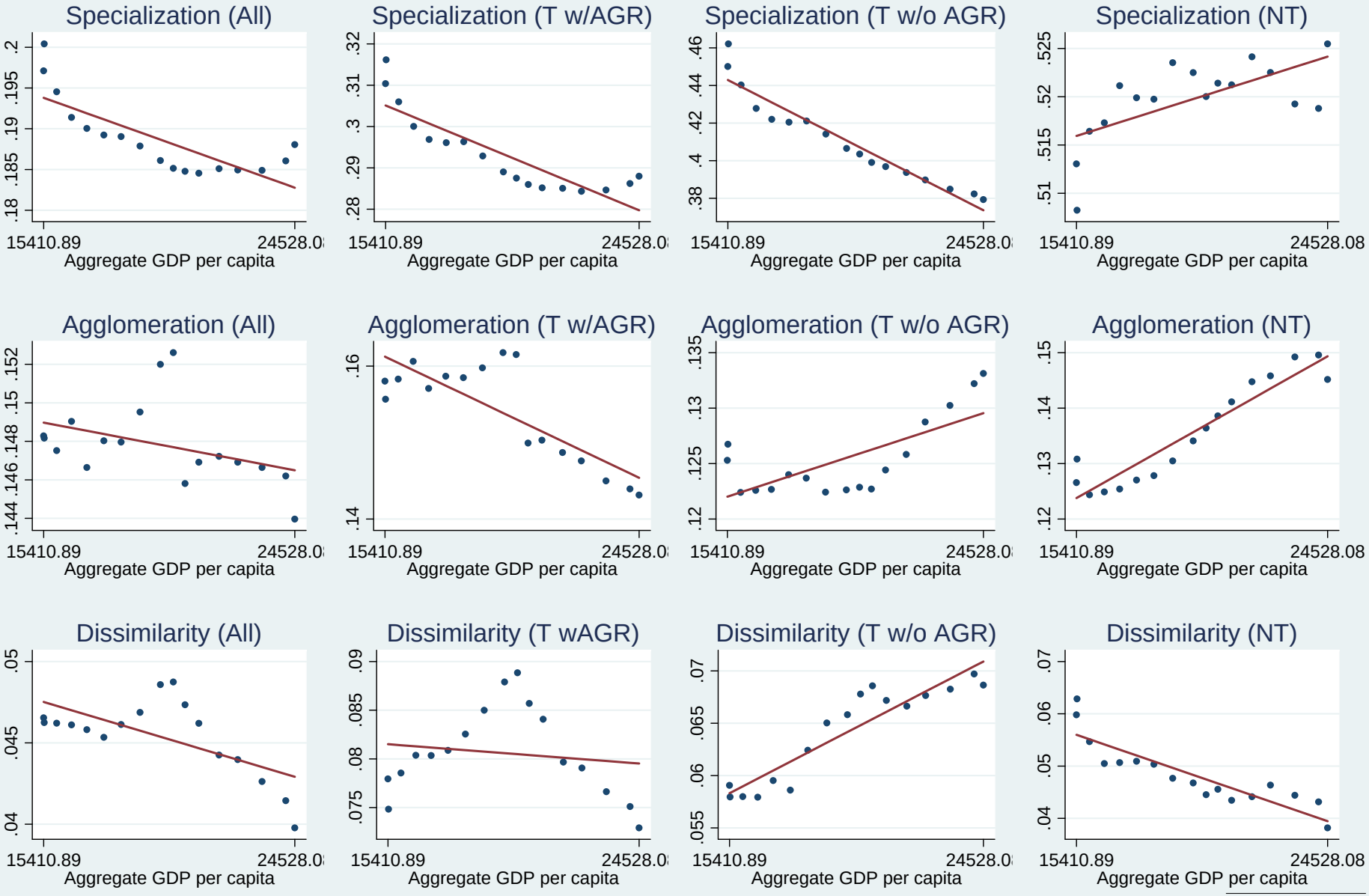


Table 2: ILO - Sectoral Data

	Specialization (All)	Agglomeration (All)	Dissimilarity (All)
EU per capita GDP	-1.21^{***}	-0.272	-0.505^{***}
	(–4.86)	(–1.64)	(–3.28)
Obs.	17	17	17
	Specialization (T w/AGR)	Agglomeration (T w/AGR)	Dissimilarity (T w/AGR)
EU per capita GDP	-2.78^{***}	-1.74^{***}	-0.217
	(–6.72)	(–5.33)	(–0.56)
Obs.	17	17	17
	Specialization (T w/oAGR)	Agglomeration (T w/oAGR)	Dissimilarity (T w/oAGR)
EU per capita GDP	-7.60^{***}	0.826^{***}	1.38^{***}
	(–13.11)	(3.84)	(9.51)
Obs.	17	17	17
	Specialization (NT)	Agglomeration (NT)	Dissimilarity (NT)
EU per capita GDP	0.901^{***}	2.81^{***}	-1.81^{***}
	(3.31)	(10.79)	(–7.37)
Obs.	17	17	17

4. Case studies: India

- Real output data at the one-digit level for a maximum of 28 States. 1980-1995. From Indian Statistical Office.
- Data must be rectangular - i.e. same sectors present in all regions over the whole time period. No missing observations.
- Sectors (or regions) are dropped so as to maximize coverage.
- Final coverage of 13 sectors in 25 regions.

Figure 3: India

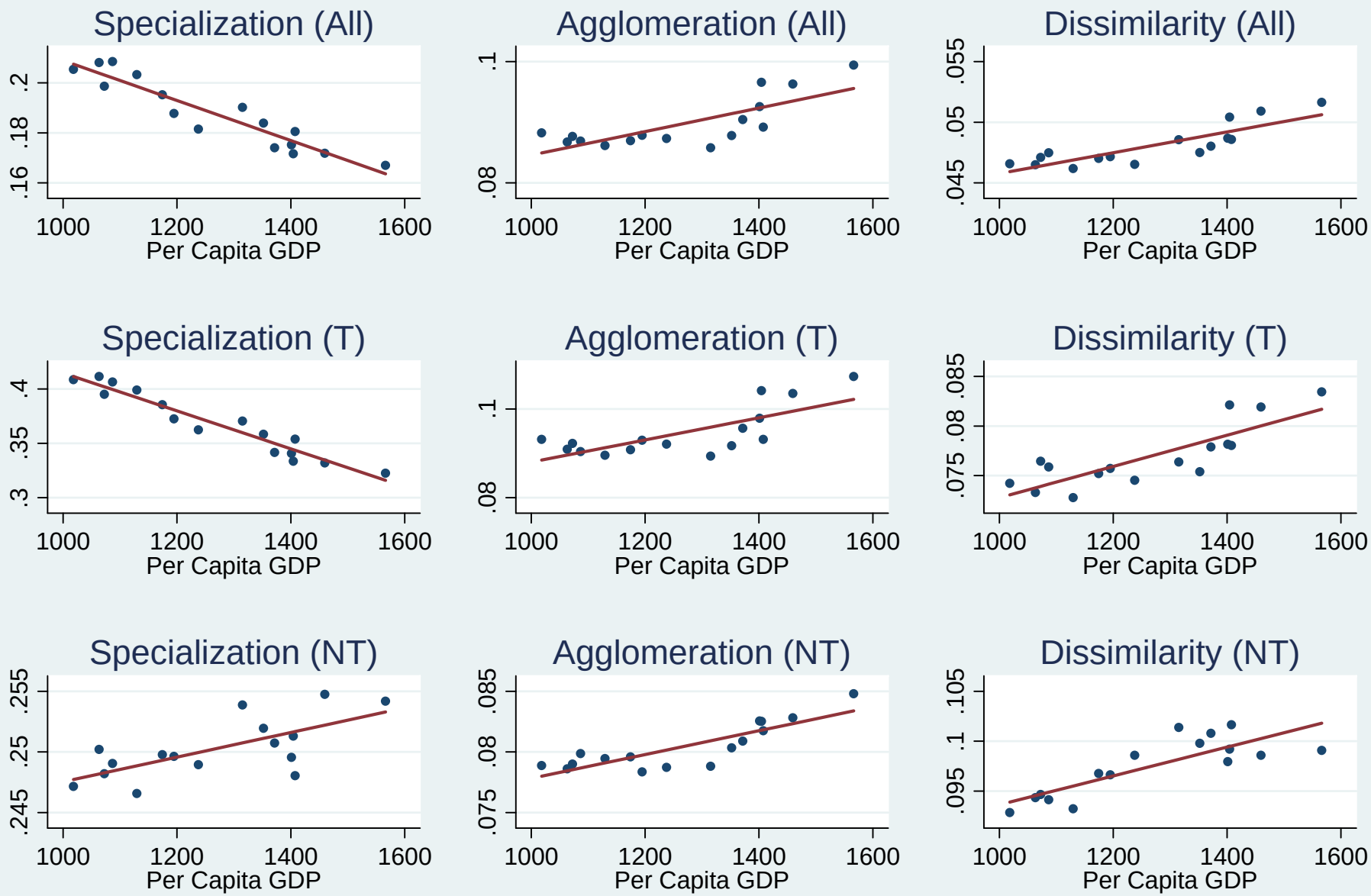


Table 3: India

	Specialization (All)	Agglomeration (All)	Dissimilarity (All)
Per capita GDP	-80.10^{***}	19.40^{***}	8.57^{***}
	(−10.34)	(4.42)	(6.11)
Obs.	16	16	16
	Specialization (T)	Agglomeration (T)	Dissimilarity (T)
Per capita GDP	-174.10^{***}	25.01^{***}	15.70^{***}
	(−13.98)	(4.09)	(5.46)
Obs.	16	16	16
	Specialization (NT)	Agglomeration (NT)	Dissimilarity (NT)
Per capita GDP	10.20^{***}	9.83^{***}	14.40^{***}
	(3.56)	(5.98)	(5.39)
Obs.	16	16	16

Notes: The Table reports coefficients estimates in regressions of various indexes on India per capita GDP. Specialization and agglomeration are measured using Herfindhal indexes. The upper panel computes indexes on the full sample of sectors. The middle panel focuses on traded sectors (Agriculture, Forestry and Fishing, Mining and Quarrying, Manufacturing, Transport, Storage and Communication, Banking and Insurance). The lower panel focuses on non-traded sectors (Construction, Trade, Hotels and Restaurants, Real Estate, Business Services, Public Administration and Other Services). Coefficients are multiplied by 10^6. Student's t-statistics are reported between parentheses. *** $^{(**,*)}$ denote significance at 1% (5%, 10%) significance levels.

Case studies - China

- Regional employment data at one-digit level for maximum of 30 provinces.
- 1995-2002: coverage only includes urban units after 2002, which is undesirable from standpoint of computing regional allocation of employment.
- Again data is made rectangular. 12 sectors (lose one) and 30 provinces.

Figure 4: China

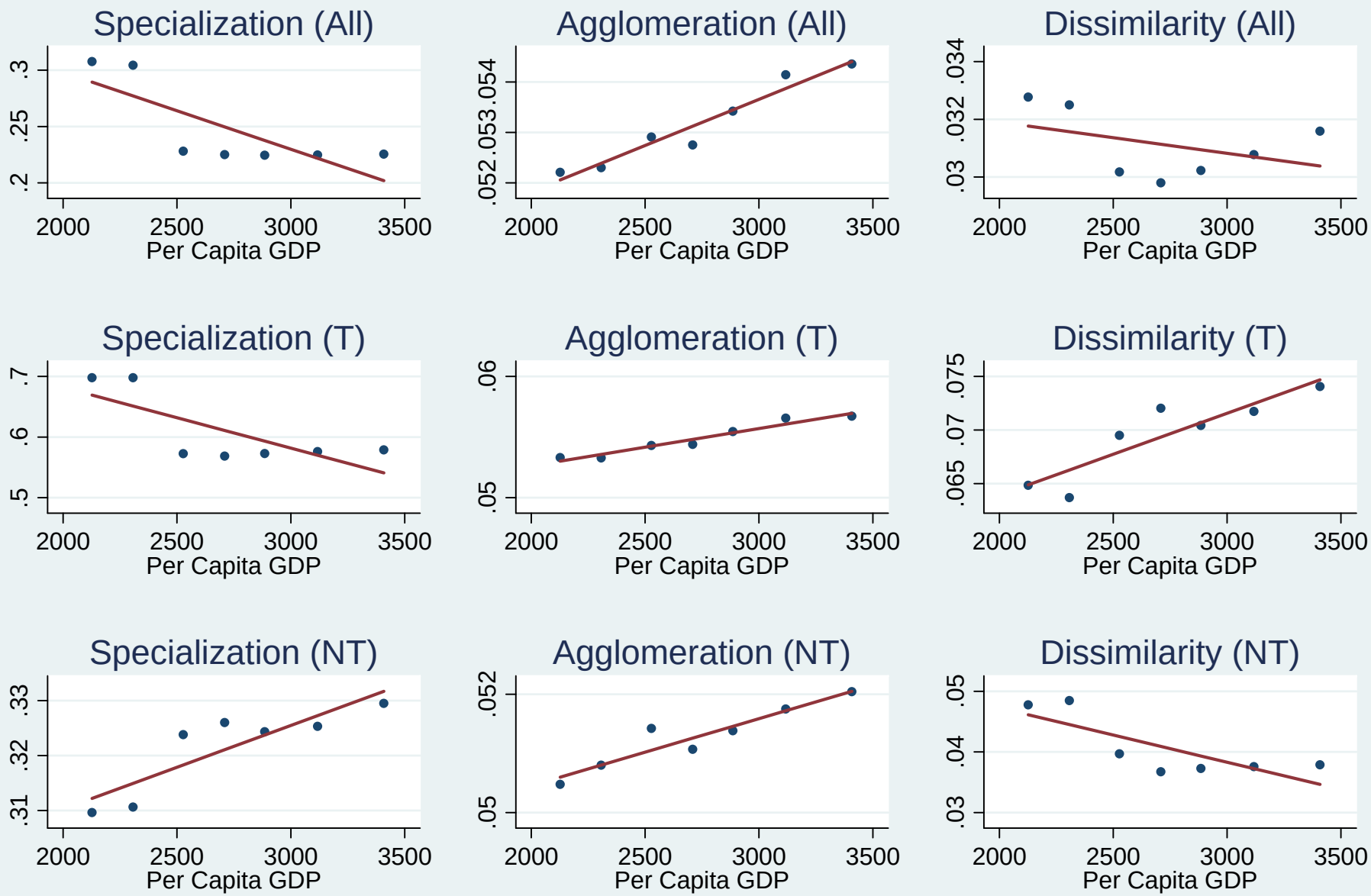


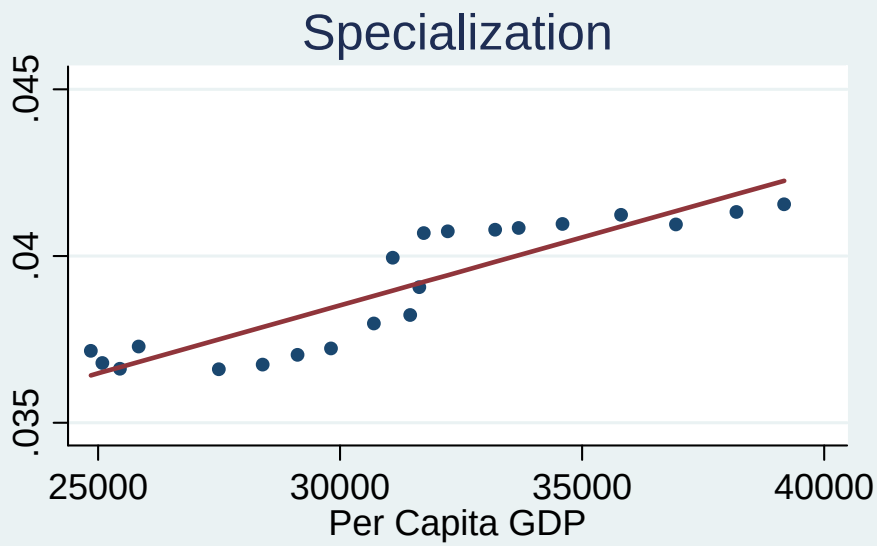
Table 4: China

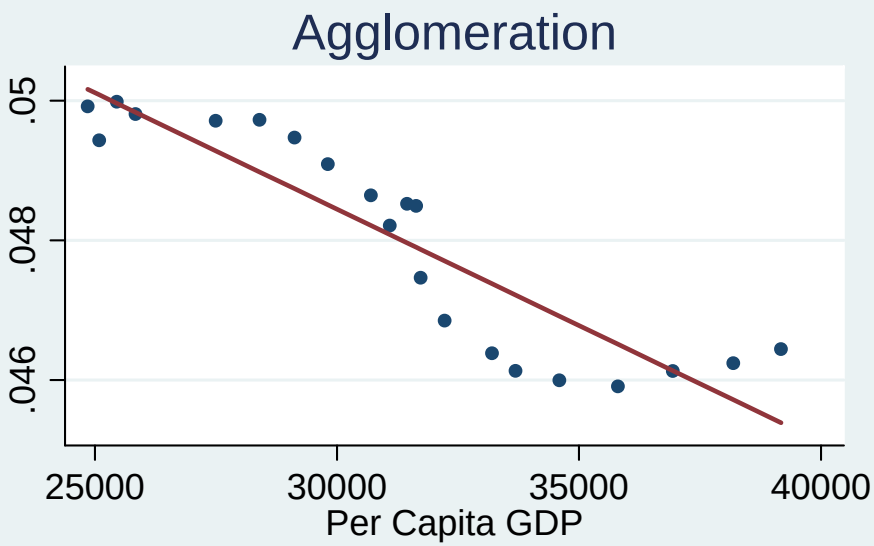
	Specialization (All)	Agglomeration (All)	Dissimilarity (All)
Per capita GDP	–68.30**	1.83***	–1.08
	(–2.82)	(8.85)	(–1.01)
Obs.	7	7	7
	Specialization (T)	Agglomeration (T)	Dissimilarity (T)
Per capita GDP	–100.10*	3.07***	7.65***
	(–2.48)	(9.33)	(4.54)
Obs.	7	7	7
	Specialization (NT)	Agglomeration (NT)	Dissimilarity (NT)
Per capita GDP	15.20***	1.13***	–8.97**
	(3.98)	(6.36)	(–2.89)
Obs.	7	7	7

Case studies - USA

- Employment (and output) data from BEA. 78 sectors, at the 4-digit SIC level, covering all sectors in 50+1 states. 1969 - 2001
- Rectangular data: 1980-2001, 69 sectors, all States+DC.

Figure 5: USA





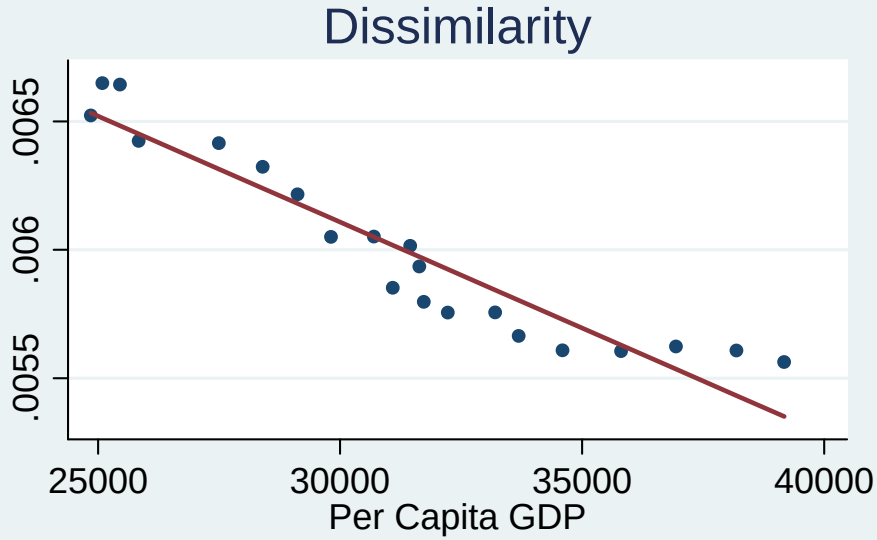


Table 5: USA

	Specialization (All)	Agglomeration (All)	Dissimilarity (All)
Per capita GDP	0.407^{***}	-0.333^{***}	-0.083^{***}
	(8.68)	(9.35)	(–12.83)
Obs.	21	21	21

Notes: The Table reports coefficients estimates in regressions of various indexes on US per capita GDP. Specialization and agglomeration are measured using Herfindhal indexes. Coefficients are multiplied by 10^6. Student's t-statistics are reported between parentheses. *** $^{(**,*)}$ denote significance at 1% (5%, 10%) significance levels.

5. Large sample results - the World

- IPUMS census data for 28 countries, out of which 19 are developing. Regional employment at one-digit level. Observations from 1960 to 2007, but most countries display fewer than 4 observations.
- Developing economies - diversify, agglomerate, become regionally dissimilar.
- Developed countries - specialize, dis-agglomerate, become regionally similar.
- But only in open sectors and regions. Open regions defined as having a share of traded goods above the country average.

Figure 6: IPUMS

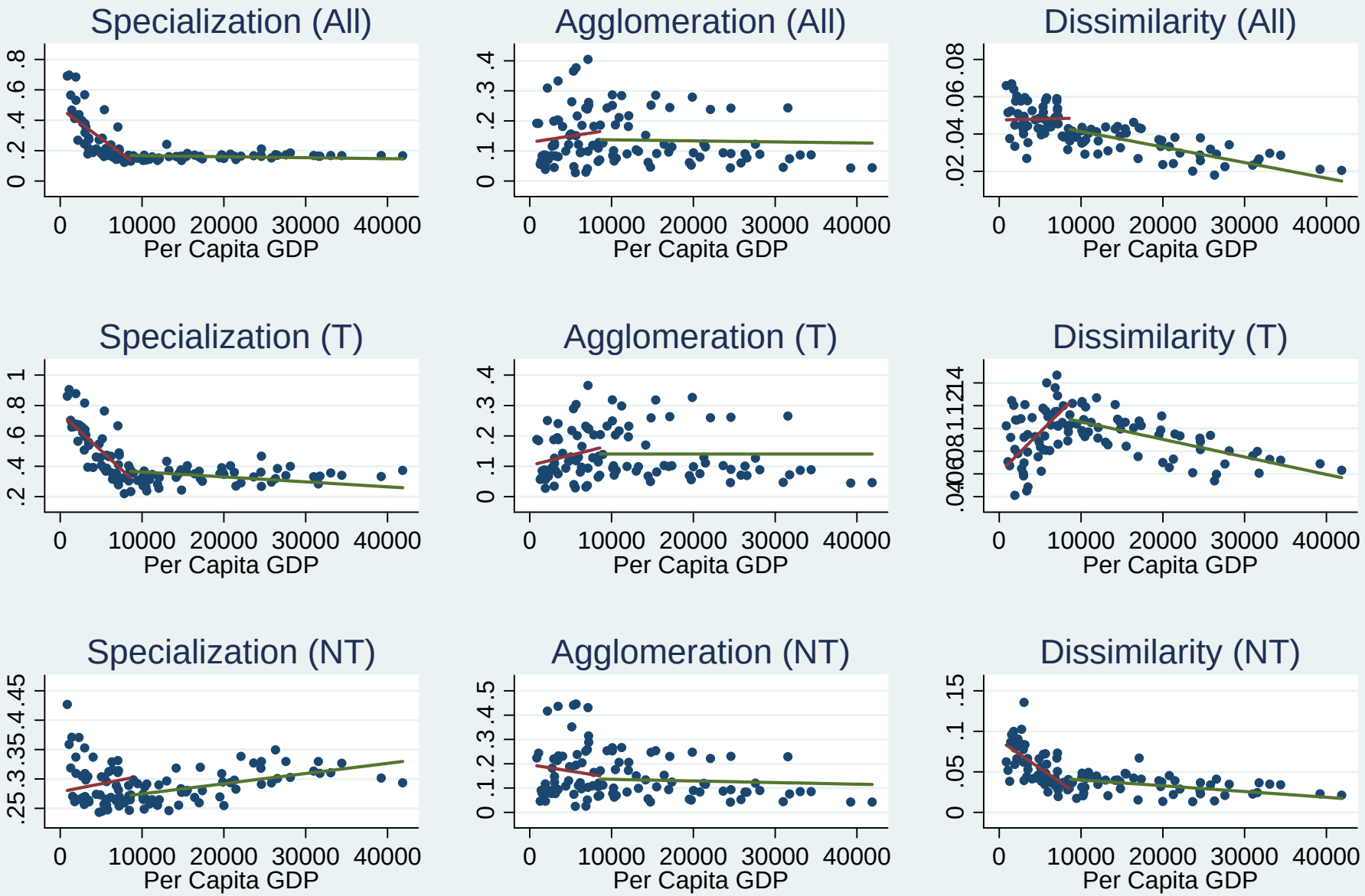


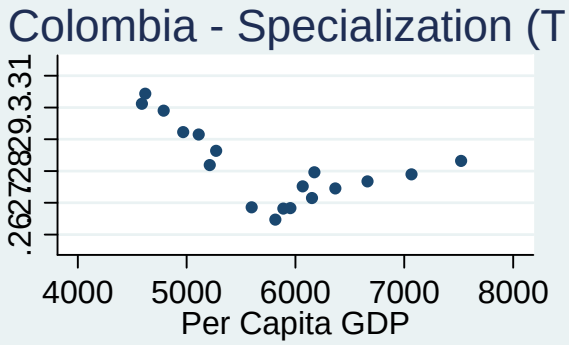
Table 6: IPUMS - International Data

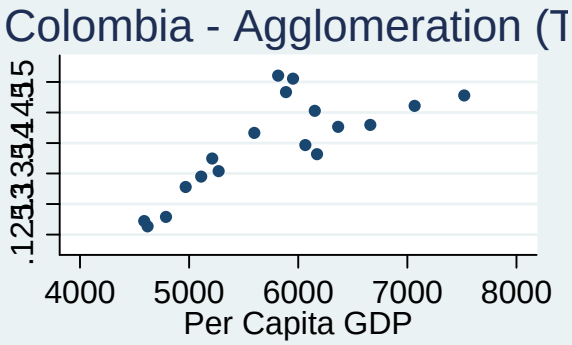
	Specialization (All)	Agglomeration (All)	Dissimilarity (All)
Low	-39.80^{***}	4.18^{***}	0.100
	(–11.71)	(2.78)	(0.16)
High	-0.648	-0.340	-0.834^{***}
	(–1.50)	(–0.86)	(–10.23)
Obs.	51	51	51
	Specialization (T)	Agglomeration (T)	Dissimilarity (T)
Low	-49.80^{***}	6.73^{***}	7.19^{***}
	(–12.38)	(3.95)	(6.64)
High	-3.27^{***}	0.006	-1.54^{***}
	(–3.96)	(0.01)	(–9.02)
Obs.	51	51	51
	Specialization (NT)	Agglomeration (NT)	Dissimilarity (NT)
Low	2.73	-5.34^{***}	-6.93^{***}
	(1.20)	(–3.50)	(–4.16)
High	1.73^{***}	-0.067^{*}	-0.712^{***}
	(3.26)	(–1.74)	(–4.18)
Obs.	51	51	51

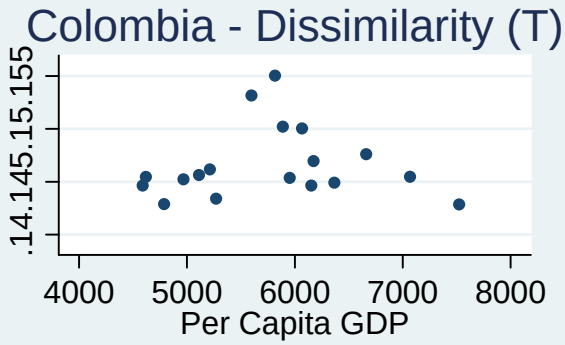
Results using output data

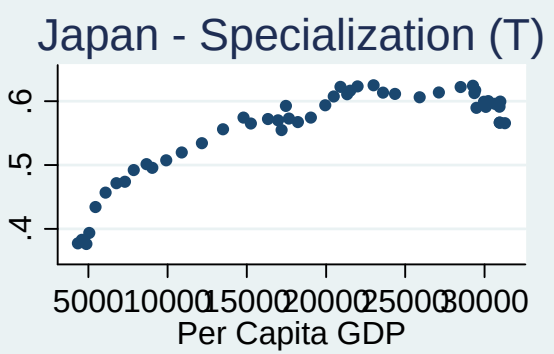
- Final sample: data from national statistical agencies.
- Sector-level, regional activity based on real value added, rather than employment.
- Regional data on sector-level real value added for 14 countries, mostly focused on developed economies. Australia, Austria, Canada, Chile, Colombia, Denmark, India, Indonesia, Japan, New Zealand, Peru, Portugal, Slovenia, and the United Kingdom.
- More substantial time coverage than census data: average of 15 years per country.

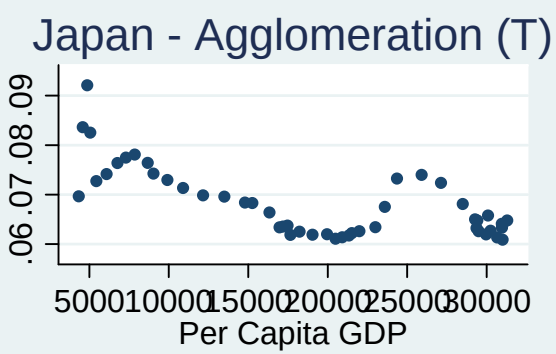
Figure 7: Examples with Output Data

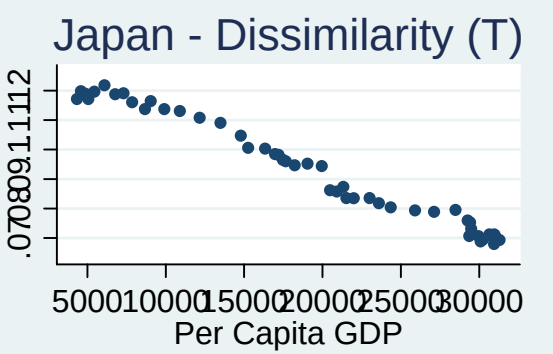


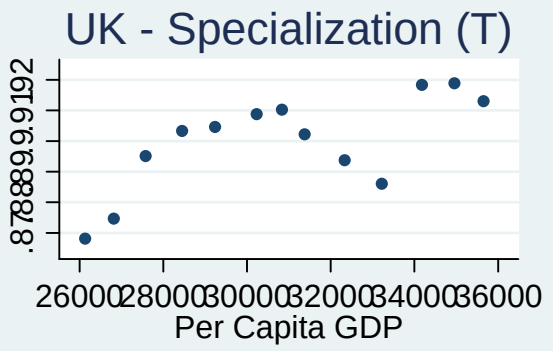


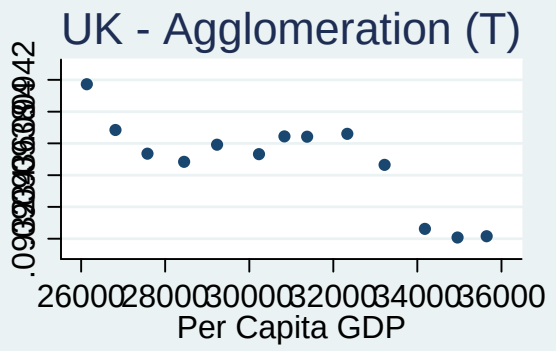












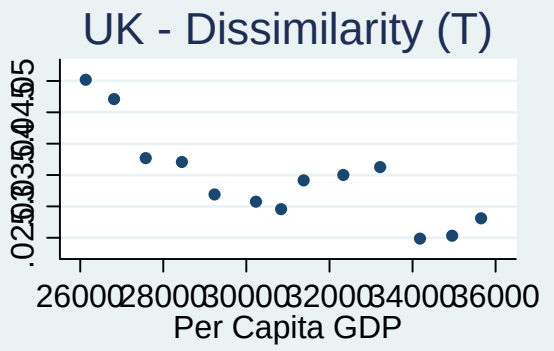


Table 7: Real Value Added Data - National Sources

	Specialization (All)	Agglomeration (All)	Dissimilarity (All)
Low	-15.70^{***}	1.91^{*}	-0.760^{*}
	(–3.48)	(1.87)	(–1.80)
Medium	-0.601^{***}	-0.229	-0.443^{***}
	(–6.43)	(–1.49)	(–10.20)
High	0.138	0.396^{*}	-0.088^{*}
	(0.98)	(1.95)	(–1.86)
	Specialization (T)	Agglomeration (T)	Dissimilarity (T)
Low	-26.70^{***}	5.29^{***}	5.40^{***}
	(–2.86)	(3.57)	(3.90)
Medium	7.29^{***}	-0.381^{**}	-1.95^{***}
	(14.98)	(–2.23)	(–10.68)
High	-1.34^{*}	3.01^{***}	1.11^{***}
	(–1.69)	(3.61)	(3.80)
	Specialization (NT)	Agglomeration (NT)	Dissimilarity (NT)
Low	-4.70^{***}	-0.058	-3.59^{***}
	(–2.97)	(–0.06)	(–2.85)
Medium	-0.698^{***}	-0.166	-0.661^{***}
	(–6.47)	(–0.96)	(–8.49)
High	0.491^{***}	-0.501^{***}	0.084
	(2.64)	(–4.39)	(0.78)

Conclusion

- Proposed a mechanism that explains jointly structural change, geographic agglomeration and regional convergence in sectoral structure.
- Structural change is a proximate symptom of economic integration. The local dimension is essential.
- "Diversification" reflects domestic integration (and regional convergence). "Specialization" reflects international integration. The stages of structural change reflect the balance between the two.
- Domestic infrastructure investments to integrate regions may be a better way to foster diversification than the heavy hand of industrial policy.