

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
- We have very few facts, and even fewer explanations for these few facts

Some Explanations

- Goods trade – Caselli and Coleman (2001), Teigner (2012). But focuses on transition from AGR.
- Access to finance - Kalemli-Ozcan et al (2003). But focuses on cross-section rather than dynamics.

A Robust Fact on Structural Change

- Countries go through stages of diversification
 - Imbs and Wacziarg (2003).
- We don't really know why: goods (or financial) trade unable to explain non-monotonicity.

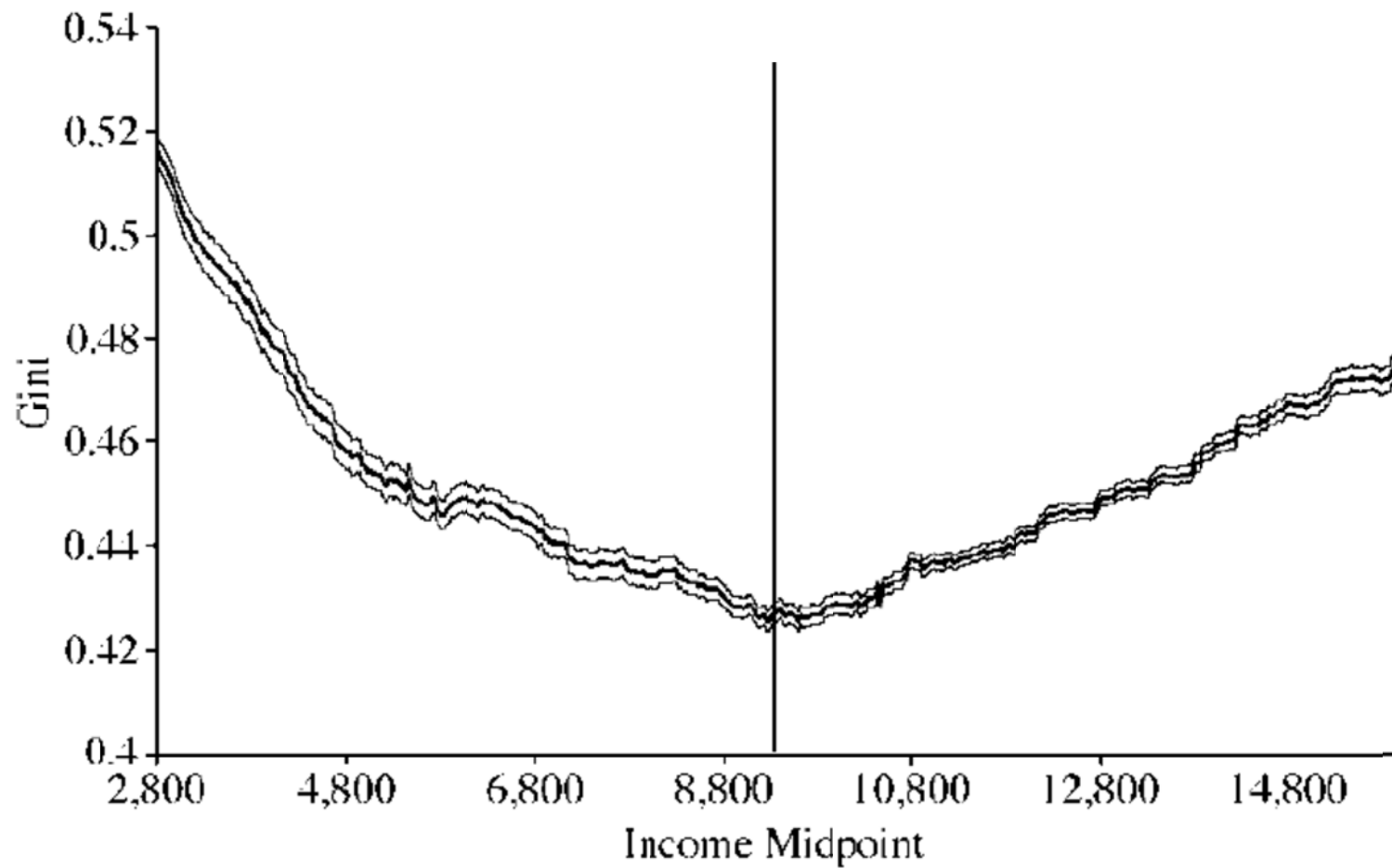


FIGURE 1. ESTIMATED CURVE (NONPARAMETRIC)—GINI INDEX—ILO 1-DIGIT EMPLOYMENT DATA

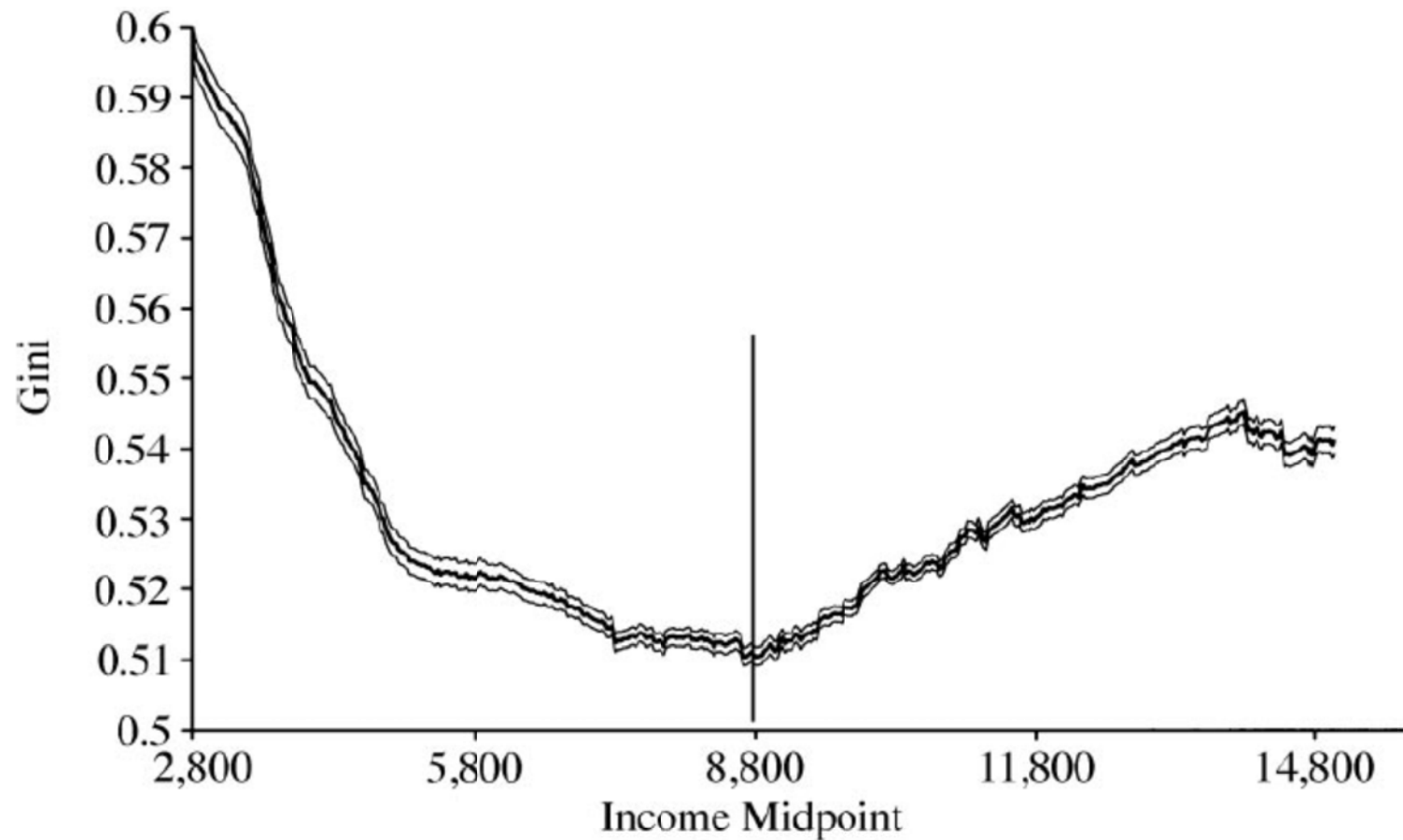


FIGURE 2. ESTIMATED CURVE (NONPARAMETRIC)—GINI INDEX—UNIDO 3-DIGIT EMPLOYMENT DATA

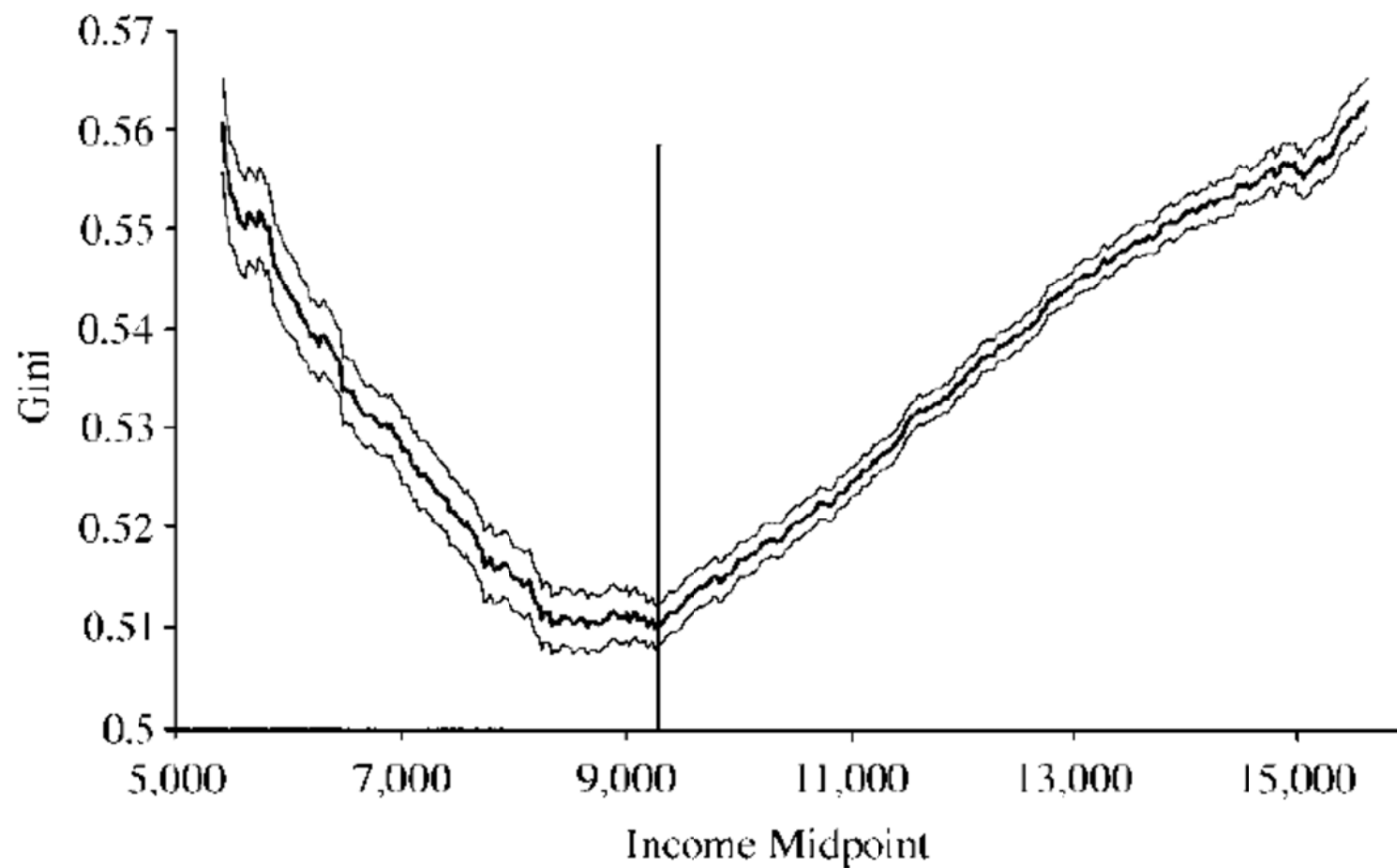


FIGURE 7. ESTIMATED CURVE (NONPARAMETRIC)—GINI INDEX—OECD 2-DIGIT EMPLOYMENT DATA

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 - which is 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).

Sectors and Regions

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

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

How We Interpret It

- Low income countries tend to be autarkic - both intra- and inter-nationally. Regions that form the country tend to themselves be autarkic .
- As local barriers to trade fall (roads, railroads, infrastructure), regions specialize in different activities. 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, infrastructure 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)
- **NB:** Areas composed of countries trading with each other become diversified, as they are constituted of countries specialized in different activities. Activity agglomerates at country level, Trading countries diverge structurally.

- Why does international comparative advantage take over from inter-regional comparative advantage?
- In first stage, 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 second stage.

How We Verify It (1)

- 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.
- **NB:** Europe *as a whole* should go through stage I: countries specialize in different activities, so that Europe diversifies as its constituent countries agglomerate.

How We Verify It (2)

- Introduce simple Ricardian framework where goods market integration implies patterns of specialization, agglomeration, dissimilarity.
- Introduce non-tradable goods, and non-trading regions. Use model to draw inferences on sub-samples focused on traded goods and/or trading regions only.
- Check predictions in data on sectoral information at regional level. Both in developing (India, China) and developed (US) countries. Then check in international panel.

How We Verify It (3)

- Test productivity convergence between regions at end of stage I.
- TBC.
- But well known that productivity does converge between trading regions.

- Measures of specialization, agglomeration, dissimilarity.
- European results
- Model with non-traded goods and non-trading regions.
- Results in developing and developed countries.

The 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.

- Gini index of sectoral specialization:

$$S_{it}^G = \frac{1}{2} - \frac{1}{S} \left(CSS - \frac{1}{2} \right)$$

where CSS is cumulated sectoral shares, $\left(\sum_j Y_{ijst} \right) / \left(\sum_s \sum_j Y_{ijst} \right)$, S is the total number of sectors.

- Neither measure actually requires regional data - since sectors are aggregated across regions.

The 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 .

- Regional Gini:

$$A_{ist}^G = \frac{1}{2} - \frac{1}{S} \left(CRA - \frac{1}{2} \right)$$

where CRA denotes cumulated regional shares $Y_{ijst} / \left(\sum_j Y_{ijst} \right)$.

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

The 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 .

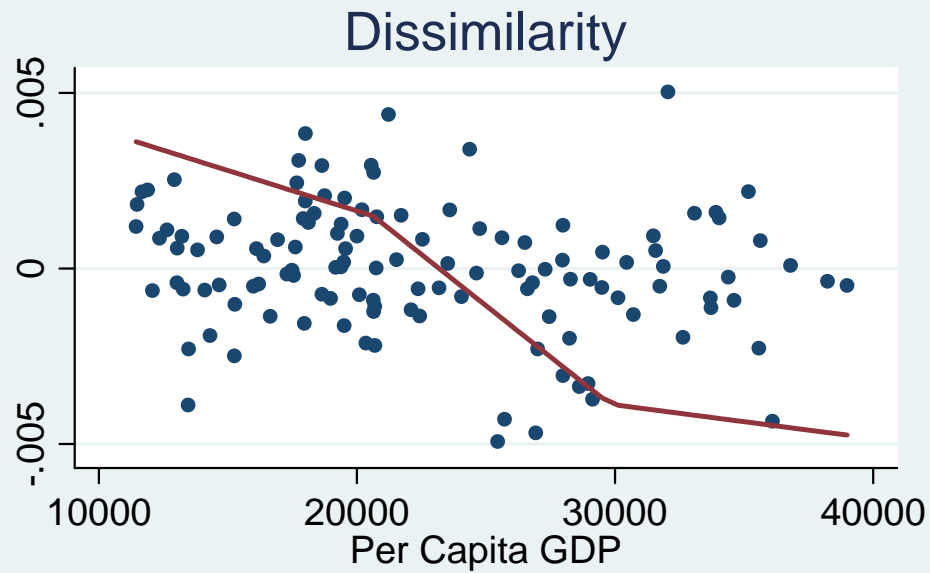
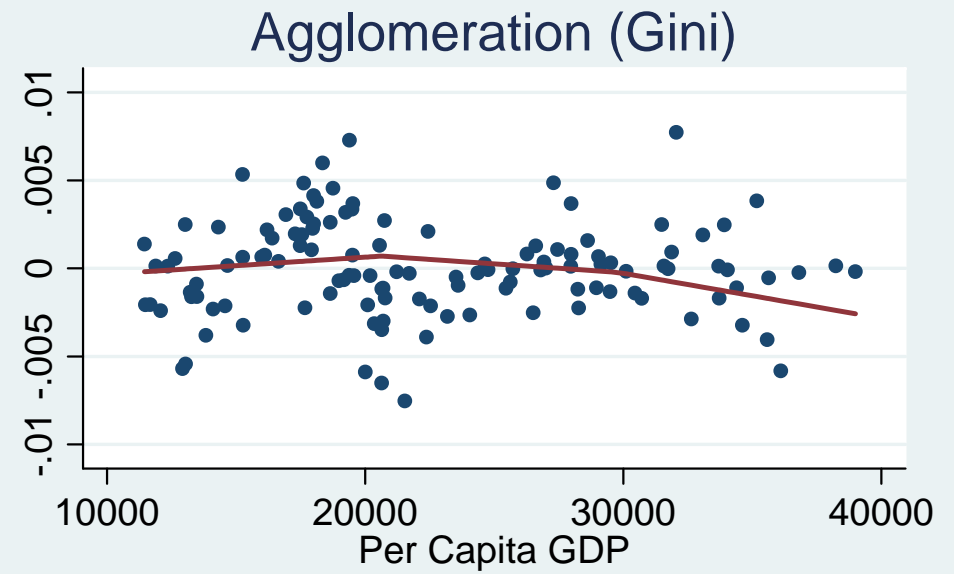
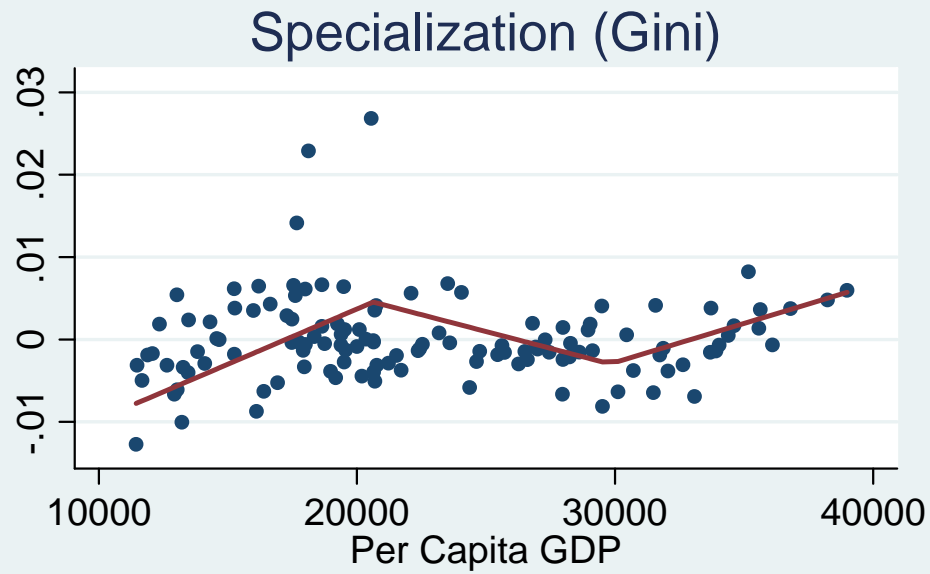
- Require sectoral information at sub-national level. Computed sector by sector: aggregated arithmetically, since dissimilarity between two regions can be high even if they are specialized in sectors that are small at country level:

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

European Countries

- The European Statistical Agency (Eurostat) collects regional employment data for member and accession countries.
- Data are available for a maximum of 11 countries, at 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 - 11 countries



	Specialization	Agglomeration	Dissimilarity
Low	7.22 (1.31)	8.39*** (3.76)	-1.13 (-0.88)
● Middle	-5.73* (-1.82)	-3.10** (-2.42)	-5.38*** (-7.30)
High	10.70*** (2.90)	-2.42 (-1.61)	-0.50 (-0.58)
Obs.	166	166	166

The European Union

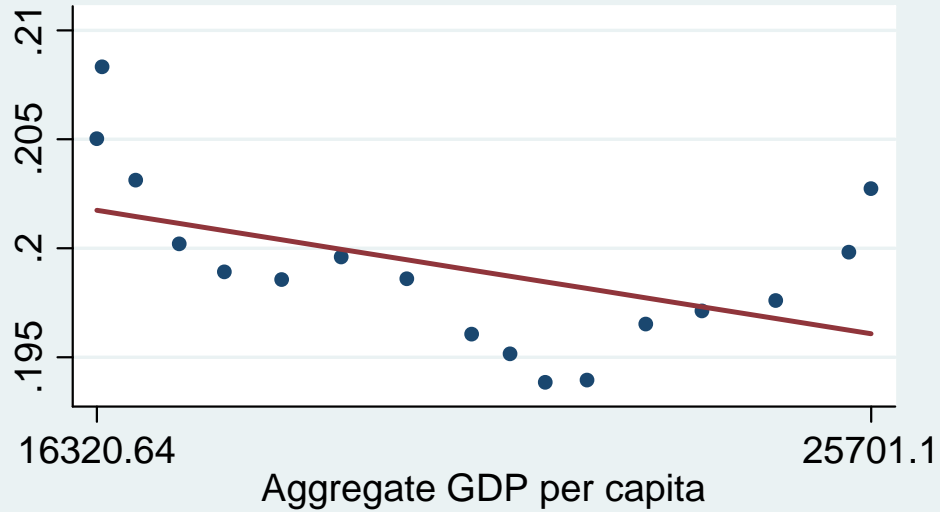
- Stage II: European countries are specializing, each country's regions are dis-agglomerating and becoming similar. Conjecture is this happens as they integrate globally - with the rest of the Union.
- Thus, the Union as a whole should be diversifying, as its constituent countries specialize in different activities. Activity should agglomerate at country level within the Union - and countries should become dissimilar.
- Can construct an economic area formed by integrating European countries - these are countries that integrate *with each other*, and so a relevant area.

The European Union

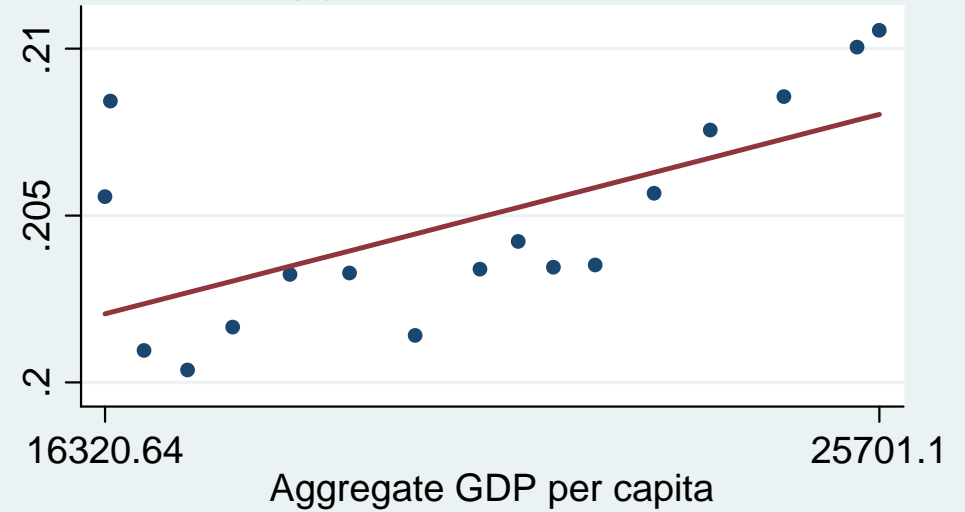
- This exercise does not require regional data, since it is now countries that represent the integrating regions of the EU.
- Use one-digit sectoral employment from International Labor Office, on the same 11 countries.
- Data must now be rectangular for the European Union as a whole - i.e. same sectors and same year coverage.
- Final coverage includes 11 countries and 8 sectors, 1969-2008.
- Unlike Eurostat, which starts collecting regional data on countries as they access the Union, ILO includes sectors and countries that are relatively closed. Raises the question of how to treat non-traded sectors and non-trading regions. Need a model.

Figure 3: ILO - All EU (11 Countries)

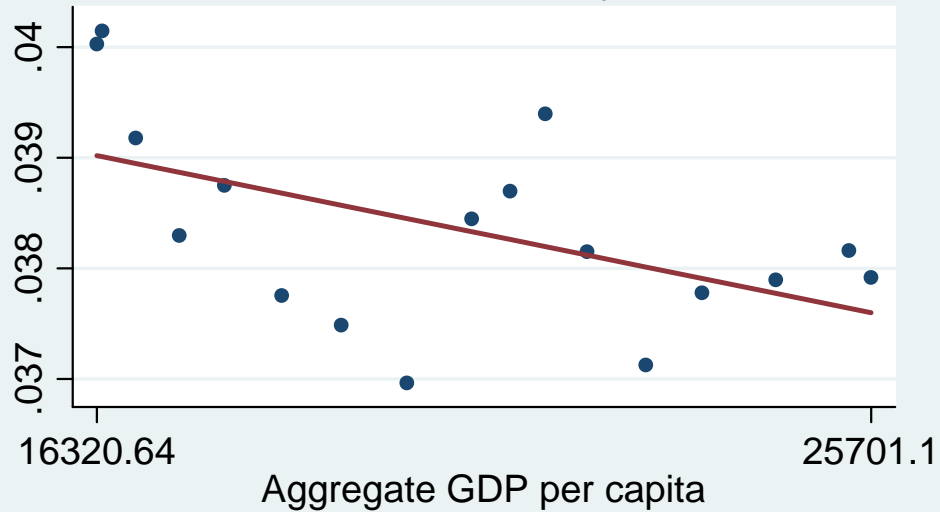
Specialization (Gini)



Agglomeration (Gini)



Dissimilarity



A simple Ricardian Model

- Three countries A, B, C . Three regions $j = 1, 2, 3$. Three sectors $s = 1, 2, 3$.
- Three periods: 1 : full (regional and country) autarky. 2 : regional goods integration but country autarky. 3 : full goods integration.
- In each region, utility is Cobb-Douglas in consumption in each sector:

$$U_j(C_{j1}, C_{j2}, C_{j3}) = C_{j1}^{1/3} C_{j2}^{1/3} C_{j3}^{1/3}$$

- Production is linear in labor (Ricardo):

$$Y_{js} = a_{js} L_{js}$$

- Production of goods 2 and 3 involve a fixed cost. Both will only be produced if market size large enough, i.e. with integration. Initially, all regions produce 1.

- First period: countries and regions are autarkic. All regions produce good 1:

$$S^H = 1$$

$$A^H < 1$$

$$D = 0$$

- Second period: Countries still autarkic, but regions can now trade. Market size makes it possible to produce goods 2 and 3. Assume regional comparative advantage so that region 1 produces good 1, region 2 produces good 2, and region 3 produces good 3:

$$S^H < 1$$

$$A^H = 1$$

$$D > 0$$

- Third period: Full integration, and productivity levels have converged across regions. International comparative advantage takes over, country is fully specialized:

$$S^H = 1$$

$$A^H < 1$$

$$D = 0$$

- Key point of the model is to introduce non-traded good (WLOG good 3) and non-trading region (WLOG region 3).
- With same assumptions, derive dynamics of three indices if they are computed on traded goods / trading regions only.

- With non-traded goods:
 - Specialization in stage II is muted, because non-traded goods survive everywhere.

- With non-trading regions:

- 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.

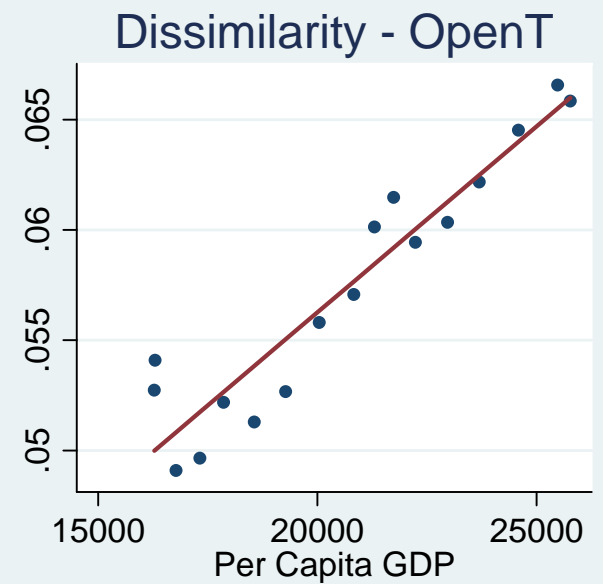
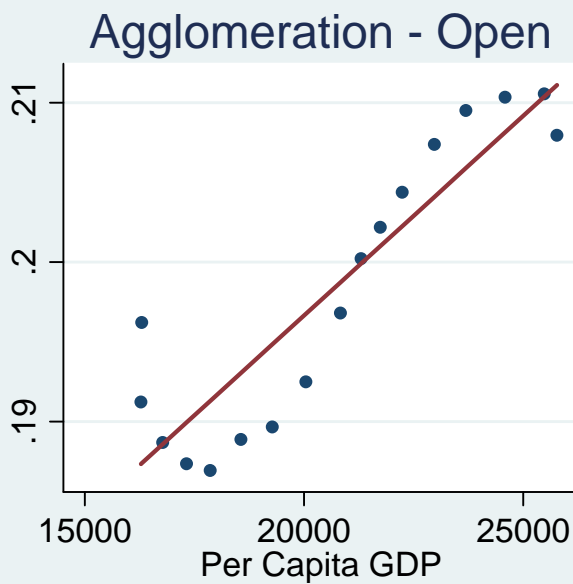
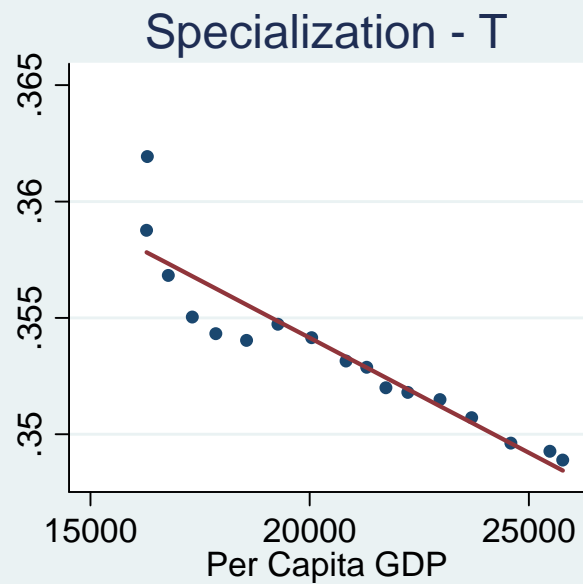
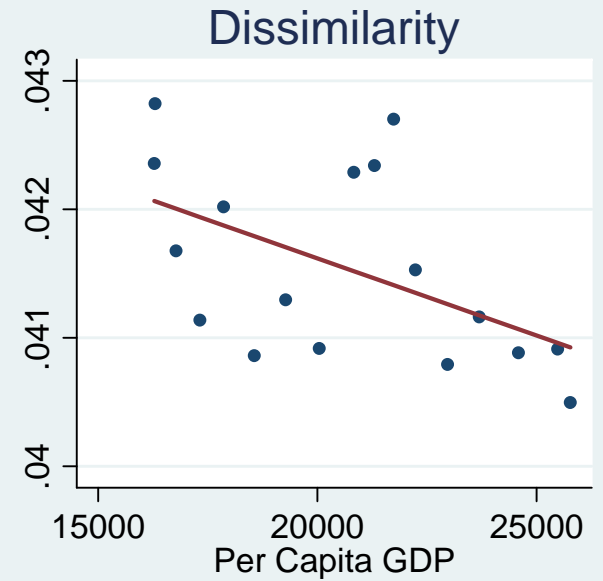
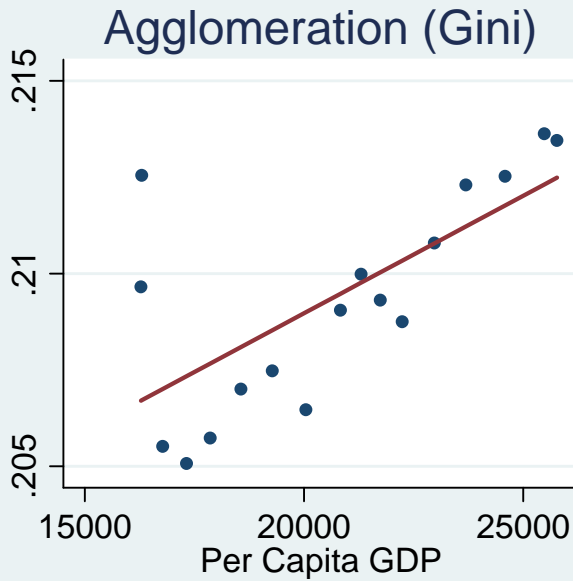
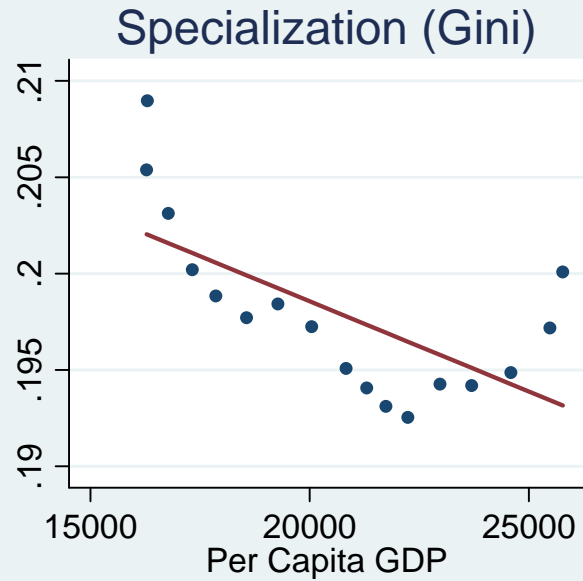
- With non-traded goods:
 - Specialization in stage II is muted, because non-traded goods survive everywhere.
 - Agglomeration (and structural divergence) in stage I are muted, because non-traded goods do not agglomerate.
- With non-trading regions:

- 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.

- With non-traded goods:
 - Specialization in stage II is muted, because non-traded goods survive everywhere.
 - Agglomeration (and structural divergence) in stage I are muted, because non-traded goods do not agglomerate.
- With non-trading regions:
 - Agglomeration (and structural divergence) in stage I are muted, because non-trading regions stick to initial production.
- 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.

- Compute indices on sub-samples.
- Non-Traded sectors are fairly standard - e.g. at one-digit level: Construction, Retail, Hotels, Other Services, Public Services and Public Administration. Note that including traded activities in non-traded classification biases against finding any difference.
- Closed regions are harder to observe. Assume closed regions are ones where non-traded employment constitutes more than a threshold percentage of overall regional employment. Threshold is specific to each country, since we are interested in relatively closed regions in a given country.

Figure 4: ILO

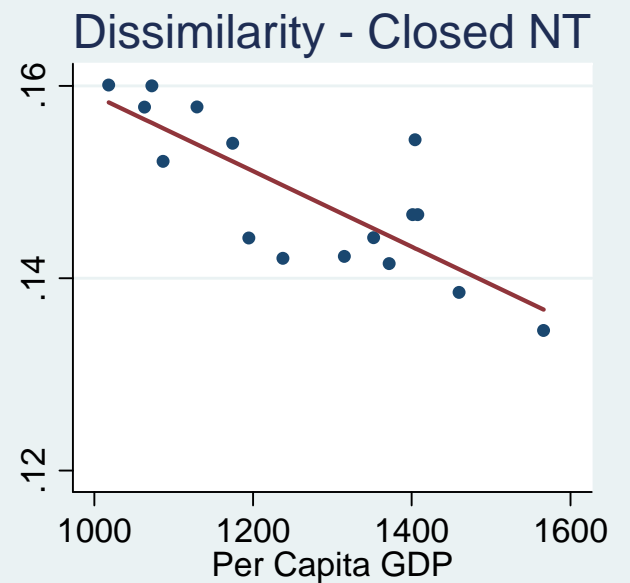
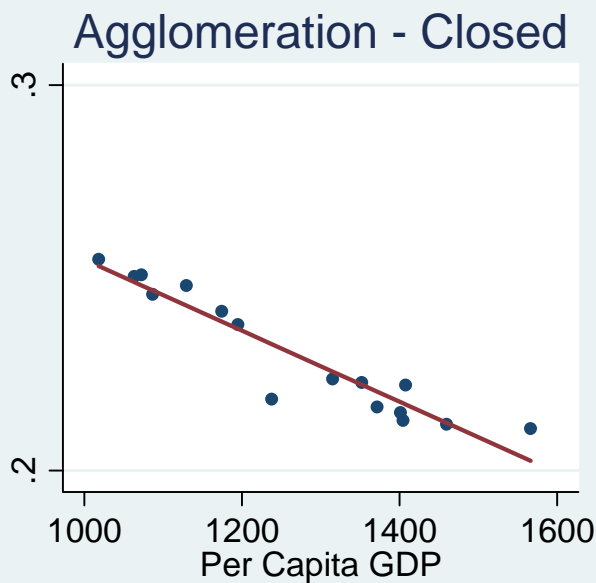
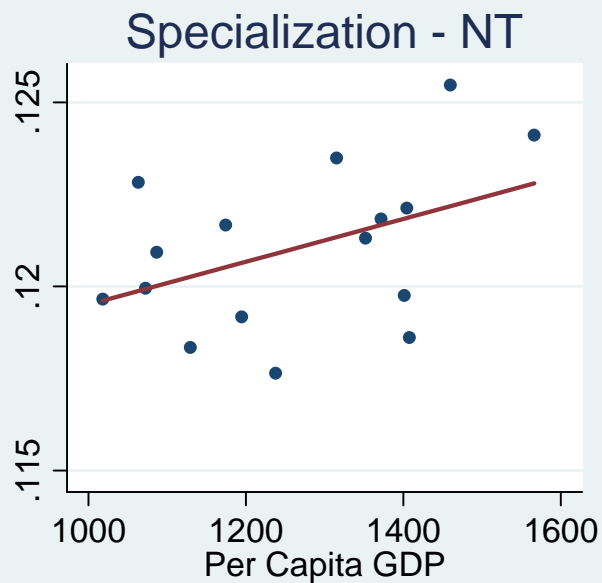
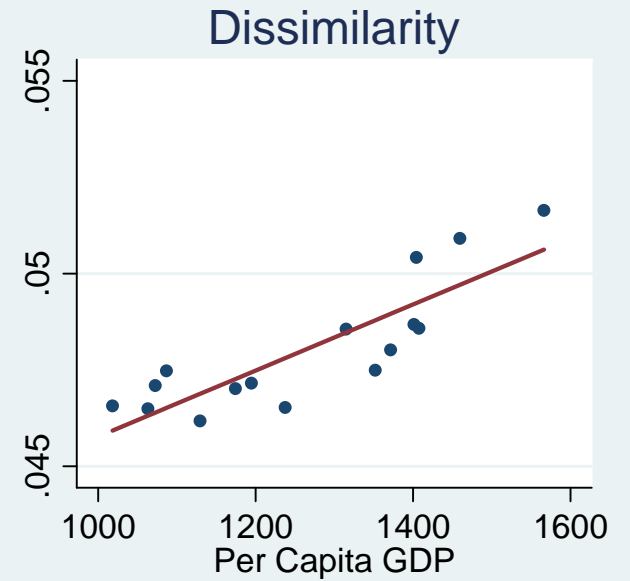
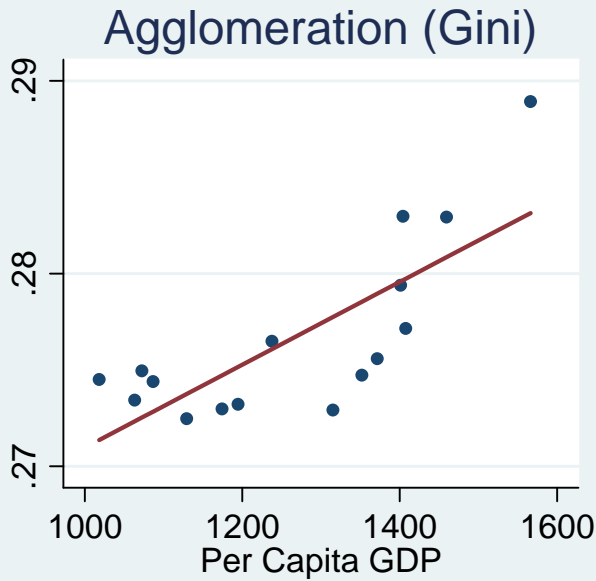
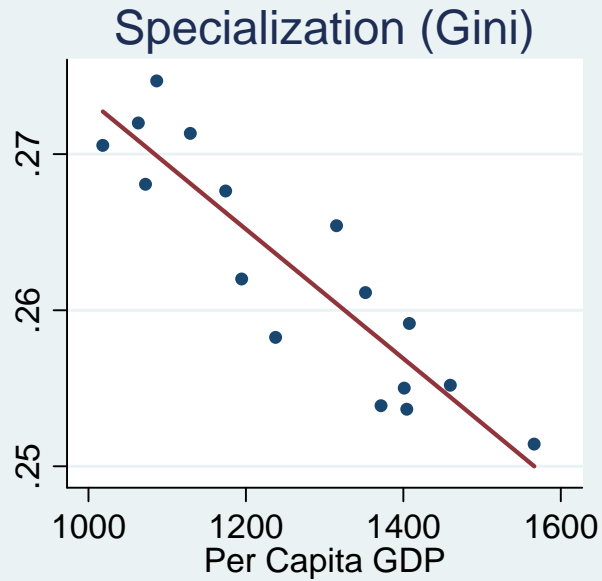


- Real output data at the one-digit level for a maximum of 28 States. 1980-1995. From Indian Statistical Office.
- Data must be rectangular - i.e. same sectors present in all regions over the whole time period. No missing observations.
- Sectors (or regions) are dropped so as to maximize coverage.
-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

The closed States of India

- Most Indian states produce agricultural goods. The share of Agriculture, Forestry and Fishing exceeds 30% of regional output in all Indian States except five: Delhi, Goa, Maharashtra, Pondicherry and Tamil Nadu.
- Criterion for open regions cannot include agricultural production, or these five regions would be closed, whereas most other States would actually be open.
- Traded sectors defined as Mining, Manufacturing, Transport, Storage, Communication, Banking and Insurance.
- Closed Indian States have production in non-traded sectors above 85% of regional output (net of Agriculture, Forestry and Fishing). Includes: A & N Islands, Arunachal Pradesh, Jammu and Kashmir, Manipur & Tripura.

Figure 1A: India

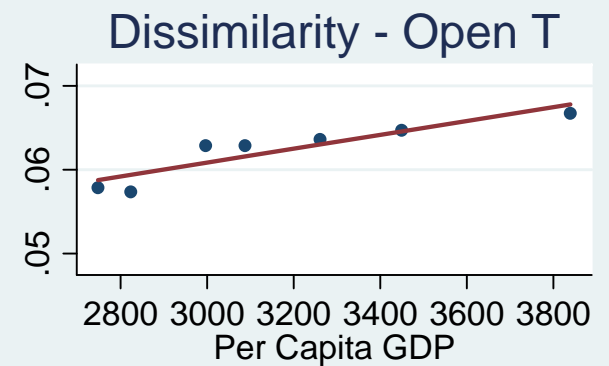
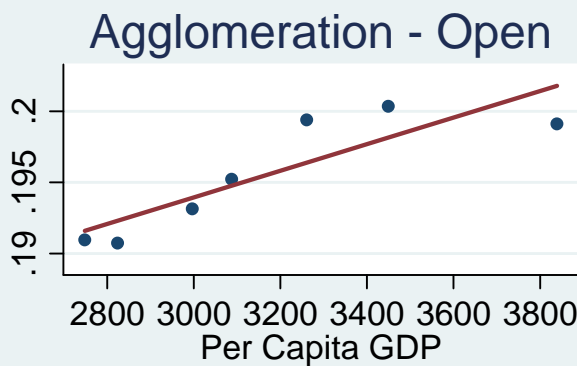
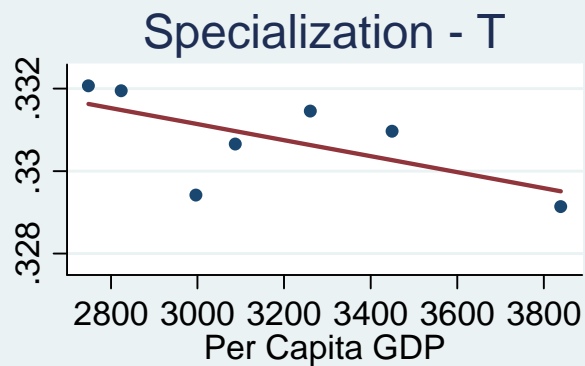
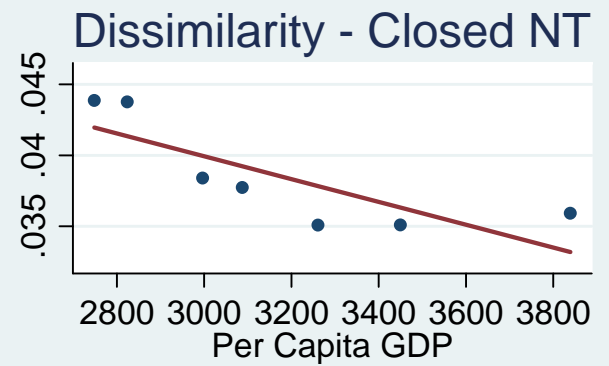
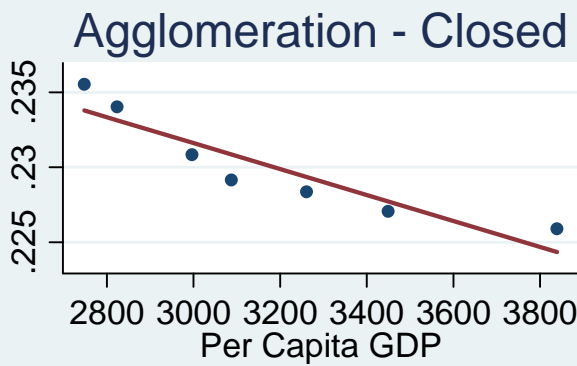
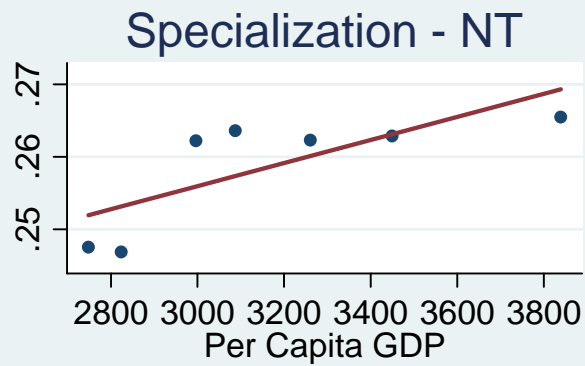
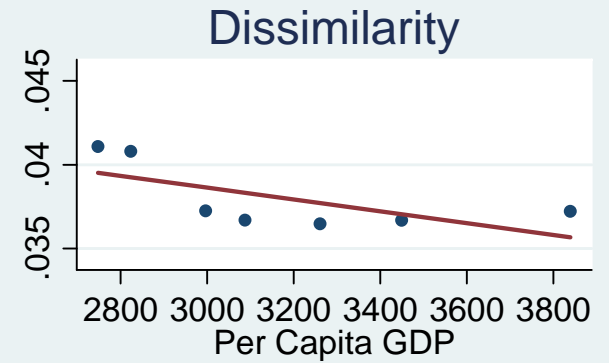
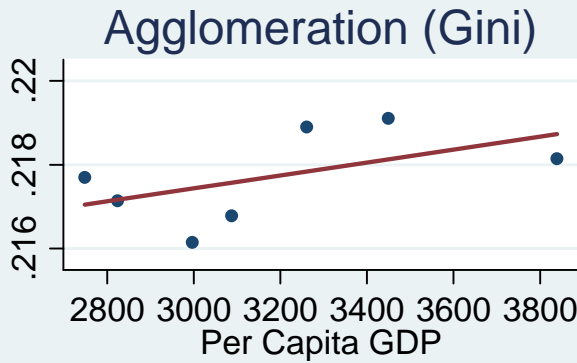
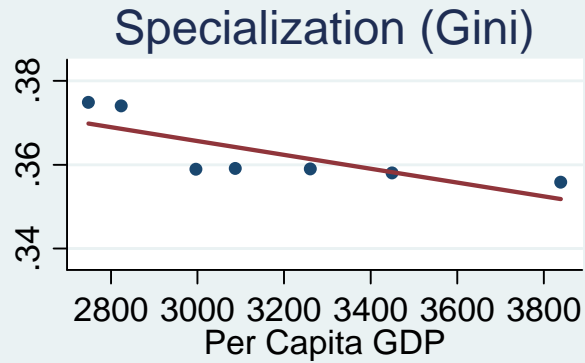


- Regional employment data at one-digit level for maximum of 30 regions.
- 1995-2002: coverage only includes urban units after 2002, which is undesirable from standpoint of computing regional allocation of employment.
- Again data is made rectangular. 12 sectors (lose one) and 30 regions.

The closed regions of China

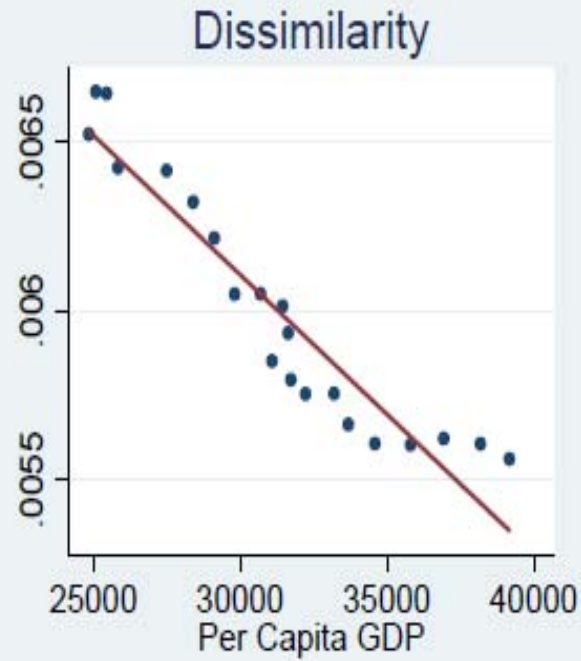
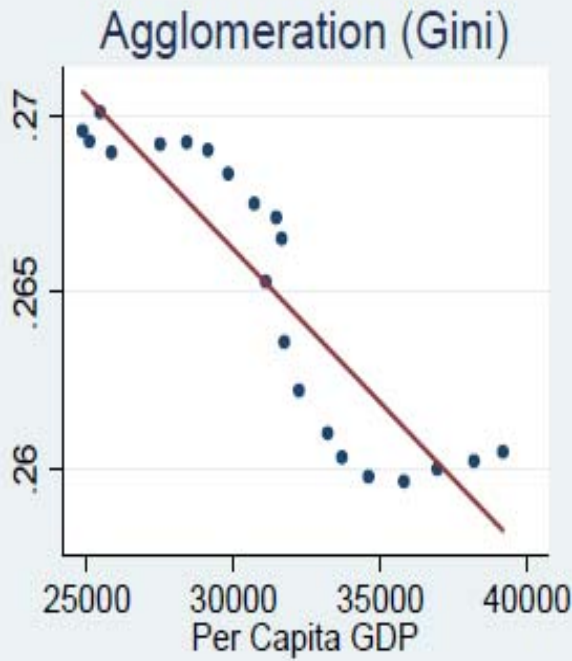
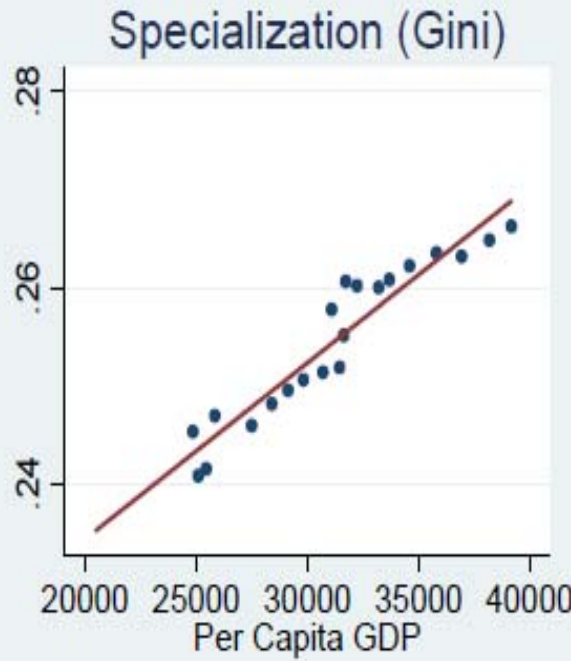
- Again agricultural employment omitted from criterion for open regions - else all regions would be open.
- Open regions are those with at least 32% of regional employment in Mining, Manufacturing, Transport, Storage, Post, Information Transmission, Computer Service, Software and Financial Intermediation. 32% is the median across regions.
- Closed regions are Anhui, Gansu, Guangxi, Guizhou, Hainan, Henan, Hunan, Inner Mongolia, Jiangxi, Ningxia, Qinghai, Sichuan+Chongqing, Tibet, Xinjiang, and Yunnan.

Figure 1B: China



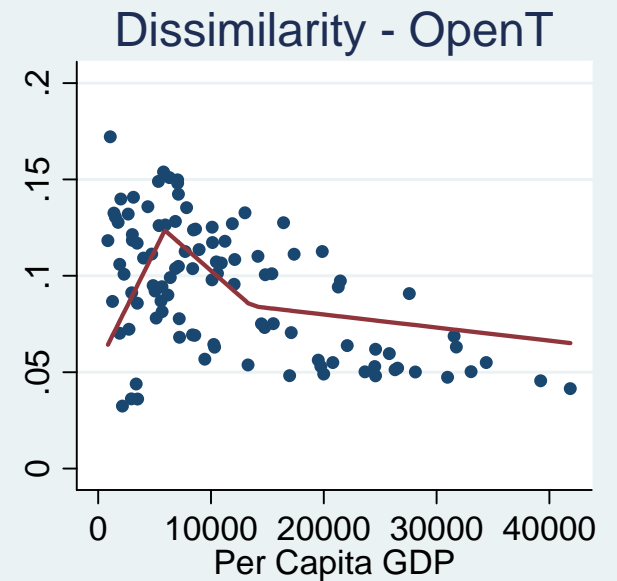
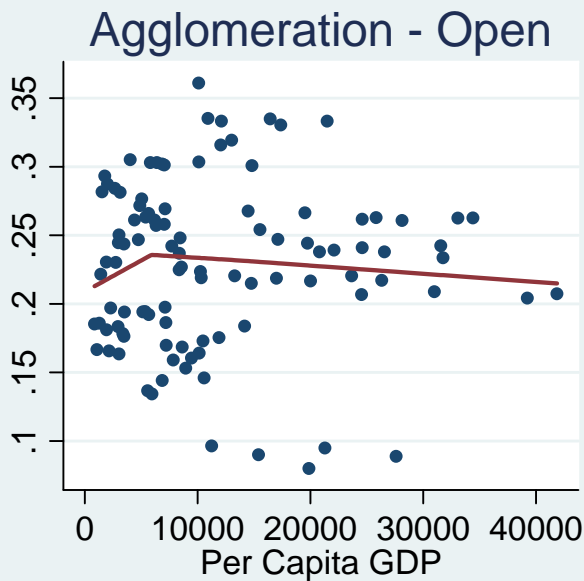
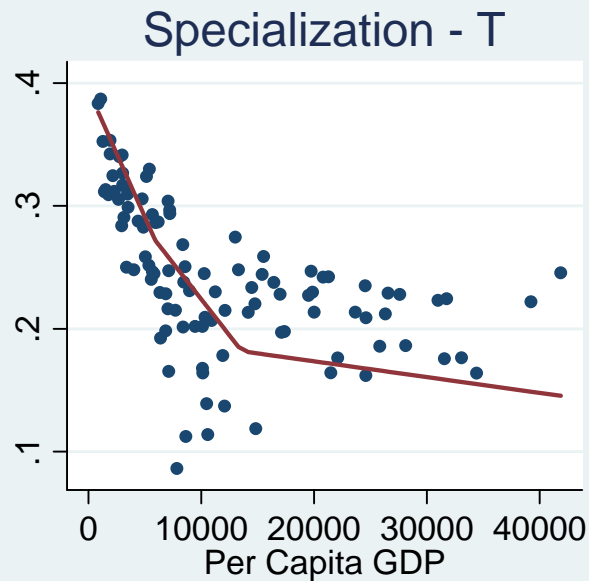
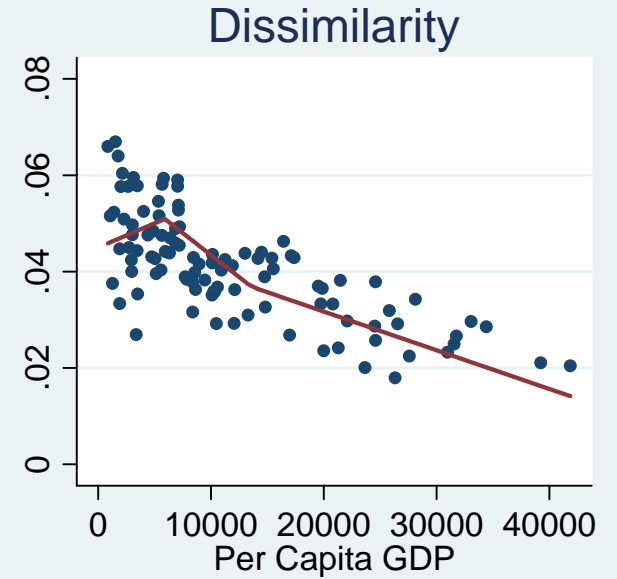
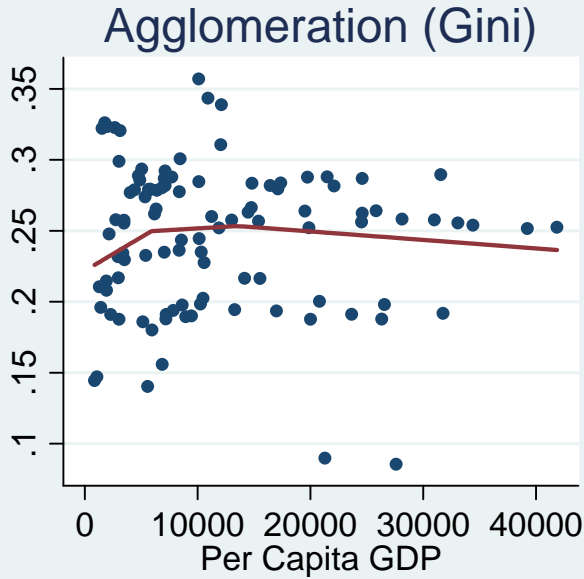
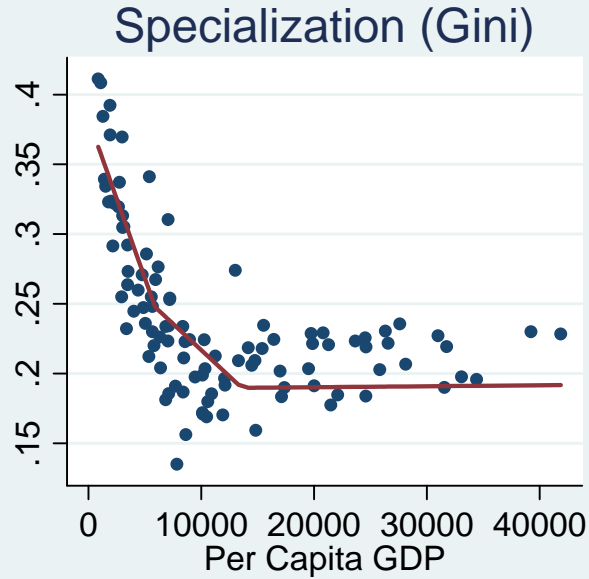
- Employment (and output) data from BEA. 78 sectors, at the 4-digit SIC level, covering all sectors in 50+1 states. 1969 - 2001
- Rectangular data: 1980-2001, 69 sectors, all States.
- Notion of "non-traded activity" elusive in US. Presumably case of fully integrated economy.

Figure 2: USA



- IPUMS census data for 28 countries, out of which 19 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 5: IPUMS



Are these significant?

	Specialization	Agglomeration	Dissimilarity
Low	-228.23*** (-9.29)	47.30*** (3.32)	10.00 (1.44)
Middle	-75.30*** (-4.94)	4.70 (0.53)	-18.30*** (-4.32)
High	0.69 (0.14)	-5.97** (-2.15)	-8.03*** (-5.91)
Obs.	103	103	103
	Specialization (T)	Agglomeration (Open)	Dissimilarity (Open T)
Low	-207.15*** (-5.98)	45.32*** (2.71)	118.20*** (6.06)
Middle	-118.21*** (-5.48)	-5.24 (-0.50)	-51.20*** (-4.24)
High	-12.80* (-1.90)	-5.95* (-1.82)	-6.79* (-1.79)
Obs.	103	103	103

- Notes: The Table reports the estimates of spline regressions performed on three quantiles of the data, labeled "Low", "Middle" and "High". All estimations include country-specific fixed effects. Coefficients are multiplied by 10^7 . Student's

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. "Specialization" reflects international integration (and regional convergence). The stages of structural change reflect the balance between the two.
- From a policy standpoint:
 - 1 Stage I: diversification can be triggered by infrastructure investment for local integration.
 - 2 Stage II: preserving diversification implies limiting international trade.