Deglobalization and the reorganization of supply chains

Effects on regional inequalities in the EU

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Context

The past 40+ years have been defined by globalization and integration

- Joint efforts to lower barriers to trade and investment
- Fragmentation of production across global value chains
- Inducing efficiency gains, lower prices, wider variety of goods, and reducing global poverty

But integration might come at a cost

- Dependency on input/output markets implies (in)direct exposures to the entire world
- Natural supply chain disruptions (e.g. Tohoku earthquake, Covid-19)
- Geopolitical tensions and outright wars

Recent signs of deglobalization?

Major political blocks have implemented various measures to

- incentivize production within their boundaries
- become less dependent on third parties

Some examples (this list is growing every day)

- **USA:** Investment and Jobs Act (2021), CHIPS and Science Act (2022), Defence Production Act (2022), Inflation Reduction Act (2022)
- **EU:** Recovery and Resilience Facility (2021), relaxation of EU state aid rules (2022), (Open) Strategic Autonomy (2013-...), RePowerEU (2023), EU Chips Act (2023)
- **Countries:** industrial policy (France, Germany, ...), security (Belgium, Art 346 TFEU)
- **Sub-national regions:** European Semiconductor Regions Alliance (2023) with 27 regions from 12 EU Member States

This paper

Consider a toolbox of supply chain policies

- Trade policy, industrial policy, and public policy

What is the impact of this toolbox of supply chain policies on

- (i) Welfare and inequality in the EU?
- (ii) Heterogeneity in economic outcomes across EU regions? (output, trade, budgets)

Develop a quantitative framework to evaluate these policies

- Multiple sectors, regions and factors, with IO linkages within/across regions
- Monopolistic competition, love for variety, and external economies of scale
- Local and supra-national (EU) governments that set policies

Simulate impact on EU and its regions (RHOMOLO database)

- 235 EU regions and 54 sectors in each region + ROW aggregates
- Input-output linkages within and across all regions

Economic activity is highly dispersed across EU regions

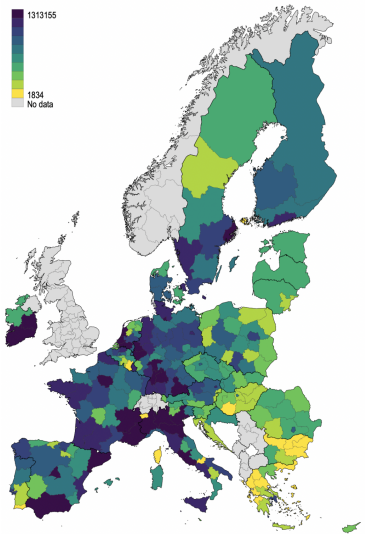


Figure: Gross output.

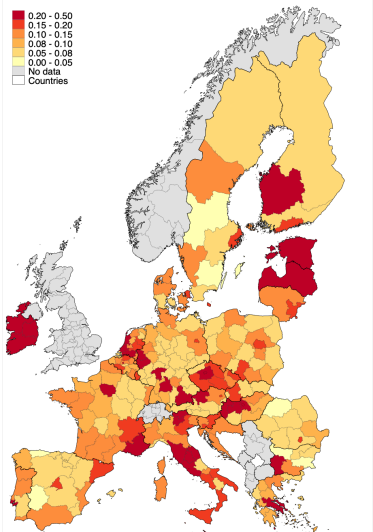
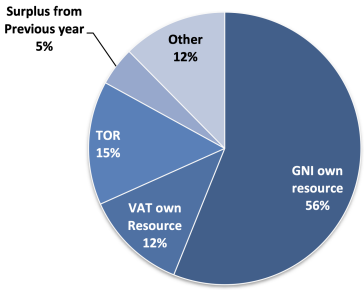


Figure: Import penetration from RoW (manufacturing).

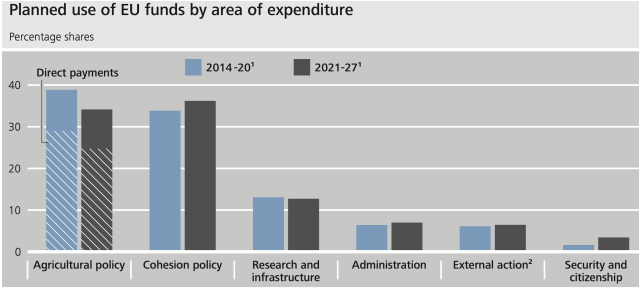
Distribution of EU budget: income and expenditures

Income side (2017)



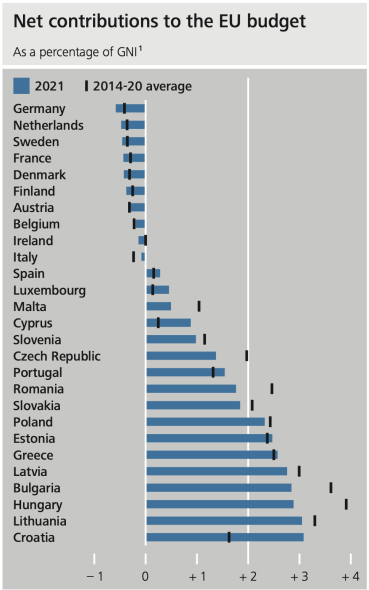
EU budget is balanced

Expenditure side (2017)



Over 1/3 of budget is spent on cohesion policies

Distribution of EU budget: regional heterogeneity



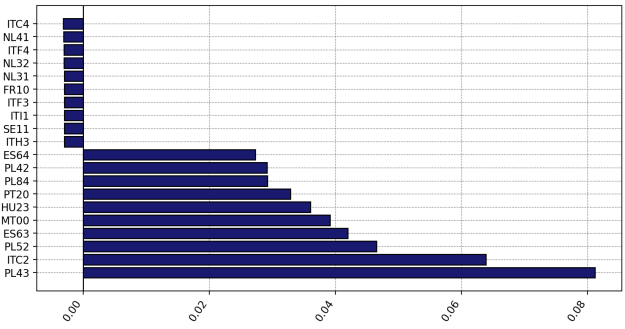


Figure: Regional net contributions

Model overview

General equilibrium model of production, consumption and trade

- Multiple regions and sectors, I/O linkages across sectors within and across regions
- Firms compete in monopolistic competition with external economies of scale
- Consumers exhibit love for variety across regions and goods

Local governments

- Set industrial policy and provide public goods
- Raise taxes and provide subsidies on production
- Can run unbalanced budgets

Supra-national government

- Sets common trade policy and industrial policy
- Redistributes local government budgets
- Runs a balanced budget

Model overview (cont'd)

General equilibrium

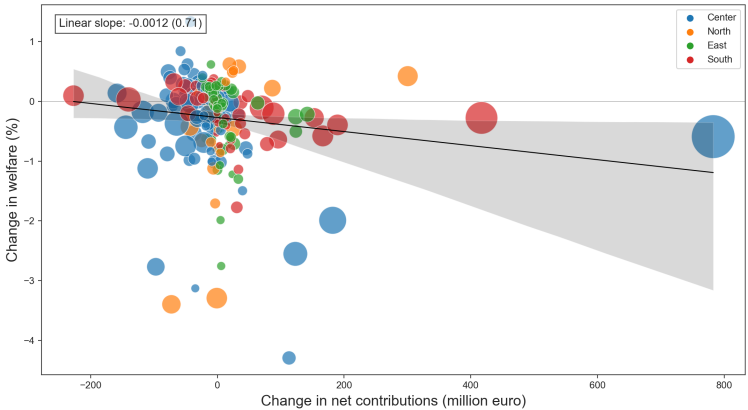
- Consumers maximize utility: love of variety across regions and goods
- Firms minimize costs: choose which sector-regions to source from & set constant markups
- Equilibrium allocation clears all goods, services and factor markets
- Economies of scale and open economies provide incentives for policy interventions

Example: an increase in production subsidies

- Lowers cost of production and thus prices
- Induces trade diversion from imports towards regional inputs, also lowering tariff revenues
- Lower costs boost outputs and exports
- Also affects downstream sector-regions (depending on exact parameter values)
- Local government can run deficit from industrial subsidies
- Supra-national tax revenues adjust endogenously to run balanced budget

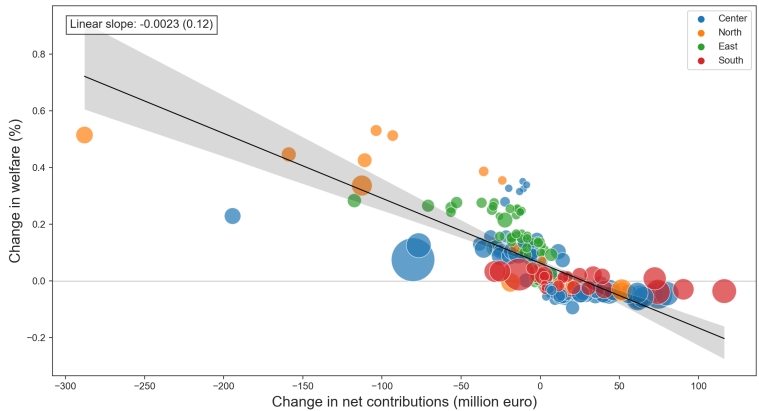
Trade policy

- Policy: 10% increase in import trade costs (set by EU govt)
- Intuition: Imports from RoW drop. Reallocation of sourcing to intra-EU, at higher prices
- Welfare: winners and losers. Large variation in {Center, North}, less for {South}
- Budget: some regions pay much more to EU budget



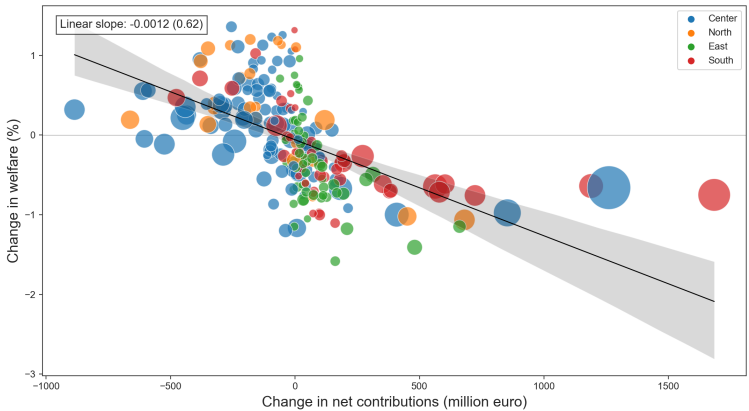
Industrial policy

- Policy: 10% increase in manufacturing production subsidies (paid by local govts)
- EU production at lower prices. Reallocation of sourcing to intra-EU, at lower prices
- Welfare: winners and losers, largest gains for {North, East}, largest losses for {South}
- Budget: various regions receive more from EU budget



Public policy

- Policy: 10% Increase in govt part of final demand (paid by local govts)
- Govt spending increases demand but households pay higher taxes. Depends on exposure.
- Welfare: winners and losers, large variation across regions
- Budget: massive variation in net contributions to EU budget



Conclusion

What is the impact of various supply chain policies on EU outcomes?

- Evaluate a rich toolbox of trade, industrial and public policies
- Each policy has a different impact on welfare and inequality
- There is massive heterogeneity in outcomes across EU regions
- These depend on which sectors you are mostly specialized in
- Each policy creates winners and losers, as well as changes in budget contributions

Next steps

- Targeted tariff analysis
- Optimal policy mix
- Non-cooperative strategic responses

Appendix

Literature

Supply chains

- **Trade and value added:** Johnson & Noguera (2012), Koopman et al. (2014)
- **Offshoring:** Grossman & Rossi-Hansberg (2008), Baldwin & Venables (2013)
- **Position:** Antras & Chor (2013), Alfaro et al. (2019), Antra's & De Gortari (2020)
- **Risks and vulnerabilities:** Eppinger et al. (2021), Bonadio et al. (2021)

GE models

- Eaton & Kortum (2002), Acemoglu et al. (2012), Caliendo & Parro (2015), Caliendo et al. (2019), Galle et al. (2022) Baqaee & Farhi (2020, 2023)

Policies in production networks

- **Trade:** Lashkaripour & Lugovskyy (2023)
- **Industrial:** Liu (2019)
- **Other:** Rubbo (2023), Bernon & Magerman (2023)

Economic geography

- **Agglomeration economics:** Marshall (1890), Krugman (1991)
- **Impact of shocks:** Caliendo et al. (2018), Fajgelbaum et al. (2019), Fajgelbaum & Schaal (2020), Conte et al. (2022), Cruz & Rossi-Hansberg (2021)

Model

Households – consumption

Representative households in region j maximize utility

$$U(G_j, C_j) = G_j^{\eta_j} C_j^{1-\eta_j}$$

where $C_j = \prod_{s=1}^{S} \left(Q_j^s\right)^{\alpha_j^s}$,

The within-industry utility aggregator has a **nested-CES structure**:

$$\underbrace{Q_j^s = \left(\sum_{i=1}^{N} (Q_{ij}^s)^{\frac{\sigma^s - 1}{\sigma^s}} \right)^{\frac{\sigma^s}{\sigma^s - 1}}}_{\text{Love of variety at the regional-level}} \qquad \underbrace{Q_{ij}^s = \left[\int_{\omega} q_{ij}^s(\omega)^{\frac{\theta^s - 1}{\theta^s}} d\omega \right]^{\frac{\theta^s}{\theta^s - 1}}}_{\text{Love of variety at the firm-level}}$$

The demand in region j for sector s goods produced in region i is:

$$q_{ij}^s(\omega) = \left(\frac{p_{ij}^s(\omega)}{P_{ij}^s} \right)^{-\theta^s} \left(\frac{P_{ij}^s}{P_j^s} \right)^{-\sigma^s} Q_j^s$$

Households – income

Three sources of income

- Inelastic labor L_j with wage w_j (perfectly mobile across sectors within regions)
- Capital K_j with rental rate r_j (same)
- A fraction of capital can be owned by households abroad, generating consumption surpluses/deficits

Total disposable income in region j is then

$$I_j = \underbrace{w_j L_j + r_j K_j}_{\text{value added}} - \underbrace{T_j^{EU}}_{\text{EU contributions}} - \underbrace{T_j^{LOC}}_{\text{local taxes}} - \underbrace{\underbrace{\sum_i \chi_{ji} r_j K_j}_{\substack{\text{fraction of domestic rents} \\ \text{owned abroad}}} + \underbrace{\sum_i \chi_{ij} r_i K_i}_{\substack{\text{fraction of foreign rents} \\ \text{owned domestically}}}}_{=D_j}$$

where $T_j^{EU} = \phi_j T^{EU}$ with:

$$\phi_j = \frac{GNI_j}{\sum_{j \in EU} GNI_j}$$

Production

Firms in sector r in region j produce a unique variety ω with CRS technology

$$q_j^r(\omega) = \left[Z_j^r l_j^r(\omega)\right]^{\gamma_j^r} \left[k_j^r(\omega)\right]^{\delta_j^r} \prod_{s=1}^{S} \left[(Q_j^{sr})^{\rho_j^{sr}}\right]^{\beta_j^r}$$

Cost minimization and profit maximization imply:

$$\text{[unit cost of input bundle]} \qquad c_j^r = \Upsilon_j^r w_j^{\gamma_j^r} r_j^{\delta_j^r} \prod_{s=1}^{S} \left(P_j^s\right)^{\beta_j^r \rho_j^{sr}}$$

$$\text{[profit-maximizing price]} \qquad p_{ij}^s(\omega) = \frac{\theta^s}{\theta^s - 1} \frac{c_i^s \psi_i^s \kappa_{ij}^s}{{Z_i^s}^{\gamma_i^s}}$$

where

- ψ_i^s is a net tax wedge with $\psi_i^s = 1 + \tilde{\psi}_i^s$ and $\tilde{\psi}_i^s \in [-1, 1]$
- $\kappa_{ij}^s = (1 + \tau_{ij}^s) d_{ij}^s$ is the trade cost parameter

Prices and returns to scale

Aggregating prices over firm-level varieties:

$$P_{ij}^s = \frac{\theta^s}{\theta^s - 1} \frac{c_i^s \psi_i^s \kappa_{ij}^s}{{Z_i^s}^{\gamma_i^s}} {M_i^s}^{-\frac{1}{\theta^s - 1}}$$

Note that sector s presents **industry-level (external) returns to scale**:

$$\mu_i^s = \frac{1}{\theta^s - 1} = -\frac{\partial \ln P_{ij}^s}{\partial \ln M_i^s}$$

Free entry in production and entry costs $c_i^s \psi_i^s f^s$ imply that:

$$M_i^s = \frac{1}{\theta^s} \frac{Y_i^s}{c_i^s \psi_i^s f^s}$$

Local governments in each region i

1. **Provide taxes T_i^s or subsidies S_i^s on production to sector s (industrial policy)**
   - Total net tax revenues are

$$\bar{T}_i = \sum_{s=1}^{S} (T_i^s - S_i^s) = \sum_{s=1}^{S} \left[c_i^s \tilde{\psi}_i^s \right]$$

2. **Provide public goods G_i^s (public policy)**
   - Total consumption is $\sum_s P_i^s G_i^s = G_i$

3. **Can run unbalanced budgets**
   - Budget constraint is given by $G_i - \bar{T}_i - T_i^{LOC} = B_i$ where B_i is the local budget deficit

The supranational government

1. **Collects taxes from regions** T^{EU}
2. **Sets common trade policy and collects tariff revenues** R_i
3. **Taxes and redistributes money to local governments running deficits** B_i
4. **Runs a balanced budget**

$$\sum_{i \in EU} \phi_i T^{EU} + \sum_{i \in EU} R_i - \sum_{i \in EU} B_i = 0$$

Thus, a region can be *net recipient* or *net contributor* of supranational funds, depending on:

$$T_i^{EU} - B_i \gtrless 0$$

Effects of industrial policy on prices

Prices of sector r in country j for goods in sector s are:

$$P_j^s = \underbrace{\left(\frac{1}{\theta^s}\right)^{-\frac{1}{\theta^s-1}}\left(\frac{\theta^s}{\theta^s-1}\right)}_{\text{constant}}\left[(c_i^s\psi_i^s\kappa_{ij}^s)^{1-\sigma^s}Z_i^{s^{\gamma_i^s(\sigma^s-1)}}\left(\frac{Y_i^s}{(c_i^s\psi_i^s)f^s}\right)^{-\frac{1-\sigma^s}{\theta^s-1}}\right]^{\frac{1}{1-\sigma^s}}$$

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Note that industrial subsidies ψ_i^s play a role both on:

- intensive margin (affecting prices of sector s)
- extensive margin (affecting the number of firms M_i^s producing in sector s)

Some intuitions on equilibrium behavior

Tax revenues T^{EU} adjusts endogenously to any policy shock

- To ensure balanced budget at the supranational level

Example 1: Increase in production subsidies ψ_i^s

- Lowers the cost of production and thus prices
- Trade diversion from imports towards regional inputs, lowering tariff revenues
- Lower costs boost exports
- Propagates downstream
- Effects on other sector-regions depend on parameter values

Example 2: Increase in public goods consumption G_i^s

- Increases both domestic and imported inputs related to this good (Leontief inverse)
- Propagates upstream
- Either raising total tariff revenues, lowering optimal T^{EU}
- Impact on domestic/imported inputs depends on equilibrium outcomes

Equilibrium responses to policy shocks

Model solution concept: Change $\hat{x} = \frac{x'}{x}$ for any variable x in the baseline vs counterfactual x'

Firms costs

$$\hat{c}_j^r = \hat{w}_j^{1-\beta_j^r} \prod_{s=1}^{S} \left(\hat{P}_j^s\right)^{\beta_j^r \rho_j^{sr}}$$

Input prices

$$\hat{P}_j^s = \left[\sum_{i=1}^{N} \lambda_{ij}^s \hat{\kappa}_{ij}^{s\,1-\sigma^s} \hat{Z}_i^{s\,\gamma_i^s(\sigma^s-1)} \left(\frac{\hat{Y}_i^s}{(\hat{c}_i^s \hat{\psi}_i^s)^{\theta^s}}\right)^{-\frac{1-\sigma^s}{\theta^s-1}}\right]^{\frac{1}{1-\sigma^s}} \tag{1}$$

Import shares

$$\lambda_{ij}^{s'} = \lambda_{ij}^s \hat{\kappa}_{ij}^{s\,1-\sigma^s} \hat{Z}_i^{s\,\gamma_i^s(\sigma^s-1)} \left(\frac{\hat{Y}_i^s}{(\hat{c}_i^s \hat{\psi}_i^s)^{\theta^s}}\right)^{-\frac{1-\sigma^s}{\theta^s-1}} \hat{P}_j^{s\,\sigma^s-1} \tag{2}$$

Total gross output

$$Y_i^{s'} = \underbrace{\sum_{r=1}^{S}\sum_{i=1}^{N} \frac{\lambda_{ij}^{s'}}{1+\tau_{ij}^{s'}} \beta_j^r \rho_j^{sr} Y_j^{r'}}_{\text{intermediates}} + \underbrace{\sum_{j=1}^{N} \frac{\lambda_{ij}^{s'}}{1+\tau_{ij}^{s'}} \alpha_i^s I_j' + \hat{P}_i^s \hat{G}_i^s \left(P_i^s G_i^s\right)}_{\text{final goods}}$$

Model calibration

- **Regional production, consumption, value chains**
  - MRIO data for RHOMOLO model (JRC at European Commission)
  - Regions: 235 EU regions, 1 RoW aggregate
  - Sectors: 55 sectors in each region

Model object	Data
X_{ij}^{sr}	Intermediate goods matrix
Y_i^s	Gross output
$w_i L_i$	Value added: compensation of employees
$\bar{T}_i^s$	Value added: net taxes on production
λ_{ij}^s	Expenditure shares, $\sum_r X_{ij}^{sr} / \sum_i \sum_r X_{ij}^{sr}$
β_j^r	IG cost share in production, $\sum_i \sum_s X_{ij}^{sr} / Y_j^r$
ρ_j^{sr}	Share of inputs bought from r, $\sum_i X_{ij}^{sr} / \sum_i \sum_s X_{ij}^{sr}$
α_i^s	Budget shares, $\frac{Y_i^s - \sum_j \sum_r \beta_j^r \rho_j^{sr} Y_j^r}{I_i}$
γ_j^r	$w_j L_j^r / Y_j^r$
μ_j^r	Net tax wedge, $\frac{\bar{T}_j^s}{\sum_i \sum_s X_{ij}^{sr} + w_j L_j + r_j K_j}$

Model calibration

- **Regional production, consumption, value chains**
  - MRIO data for RHOMOLO model (JRC at European Commission)
  - Regions: 235 EU regions, 1 RoW aggregate
  - Sectors: 55 sectors in each region
- **EU transfers to NUTS2 regions**
  - Cohesion data on Open Data Platform of European Commission
  - Data for 2017, covers different programming periods (2007-2013, 2014-2020)
  - Initial values for B_i
- **Trade and scale elasticities**
  - Estimates from Lashkaripour and Lugovskyy (2023)