Deglobalization and the reorganization of supply chains

Effects on regional inequalities in the EU

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A massive wave of globalization has ended

Globalization came to a standstill since 2008

- Natural supply chain disruptions (e.g. Tohoku earthquake, Covid-19).
- Geopolitical tensions and outright wars (US, EU, RU and China).
- Painfully revealing vulnerabilities from (in)direct exposures to the entire world.

Major political blocks have since then implemented various measures to

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

Some examples

USA: Investment and Jobs Act (2021), CHIPS and Science Act (2022), Defence Production Act (2022), Inflation Reduction Act (2022).

EU: Open Strategic Autonomy (2013-...), Recovery and Resilience Facility (2021), relaxation of EU state aid rules (2022), RePowerEU (2023), EU Chips Act (2023), Industrial Deal (?).

Individual countries: industrial policy (France, Germany, ...), security (Art 346 TFEU).

Sub-national regions: European Semiconductor Regions Alliance (2023) with 27 regions from 12 EU Member States.

This paper

What is the impact of policies that aim to increase domestic production and/or consumption on

- (i) Aggregate welfare for the EU?
- (ii) Heterogeneity in outcomes across EU regions?

Why is it important?

- Both aggregate and local policies can have highly heterogeneous effects on regions.
- Directly and indirectly through complex production and consumption linkages.
- Yet we know next to nothing on how these regions are affected by policies.

What we do

Consider a toolbox of various policies

- Trade, industrial, and public policy.

Develop a quantitative framework to evaluate these policies

- Multiple sectors and regions, with input-output linkages within and across regions.
- External economies of scale, love for variety across goods and countries, public goods.
- Multi-layer governments that set policies, taxes/subsidies and allocate budgets.
- Nests ACR (2012) and Lashkaripour Lugovskyy (2023) as special cases.

Quantify the impact on the EU and its regions

- 235 EU regions + 18 ROW aggregates, with 55 sectors in each region.

Preview of results

Aggregate welfare effects

- Trade policy generates negative welfare effects.
- Industrial and public policy generate positive welfare effects.

The contribution of ACR, external economies of scale and input-output linkages

- EES contribute positively to welfare in each scenario.
- Input-output linkages contribute most to welfare changes under each policy.

Regional heterogeneity

- Even when aggregate effects are small, there is massive variation across regional outcomes.
- Within countries, some regions are top winners and others top losers under same policy.
- A region can win under one policy and lose in another.

Related literature

General equilibrium: Eaton Kortum (2002), Acemoglu et al. (2012), Caliendo Parro (2015), Caliendo et al. (2019), Galle et al. (2023), Baqaee Farhi (2020, 2024).

Policies: Grossman (1985), Neumark Simpson (2014), Campolmi et al. (2022), Lashkaripour Lugovskyy (2023), Liu (2019), Juhasz et al. (2023), Rubbo (2023).

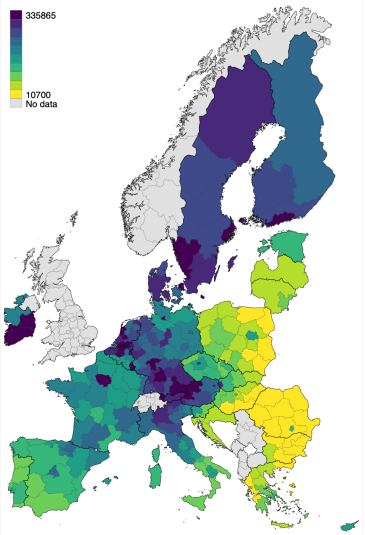
Economic geography: Marshall (1890), Krugman (1991), Caliendo et al. (2018), Fajgelbaum et al. (2019), Fajgelbaum Schaal (2020), Cruz Rossi-Hansberg (2021), Conte et al. (2022).

Supply chain analysis: Johnson Noguera (2012), Koopman et al. (2014), Grossman Rossi-Hansberg (2008), Baldwin Venables (2013), Antras Chor (2013), Alfaro et al. (2019), Antras De Gortari (2020), Eppinger et al. (2021), Bonadio et al. (2021).

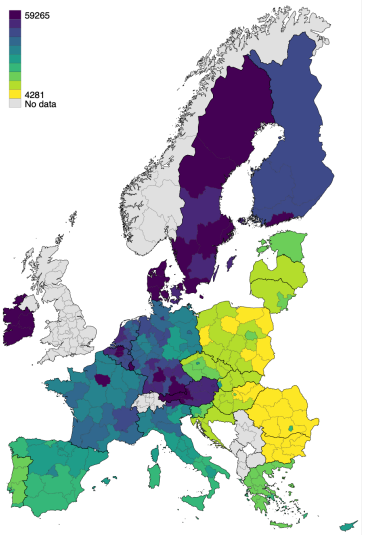
Our approach: Policy toolbox for economies with EES, IO linkages, public goods and multi-layer governments

Agenda

Economic activity is highly dispersed across EU regions (NUTS2, 2017)

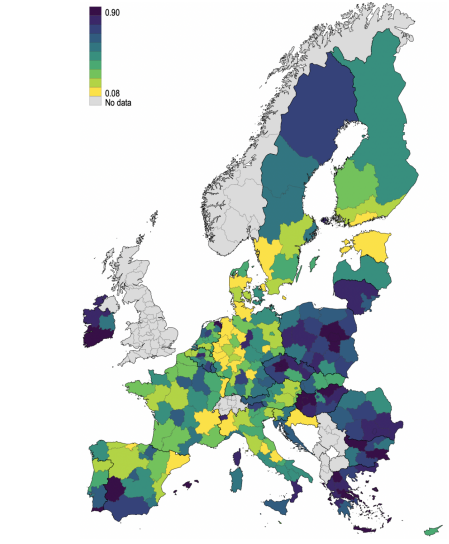


Gross output per capita.

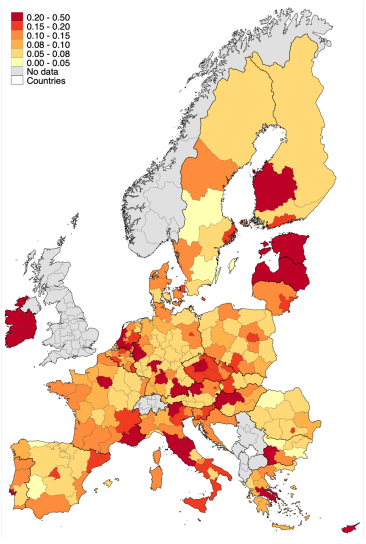


Gross National Income per capita.

As well as specialization patterns (NUTS2, 2017)



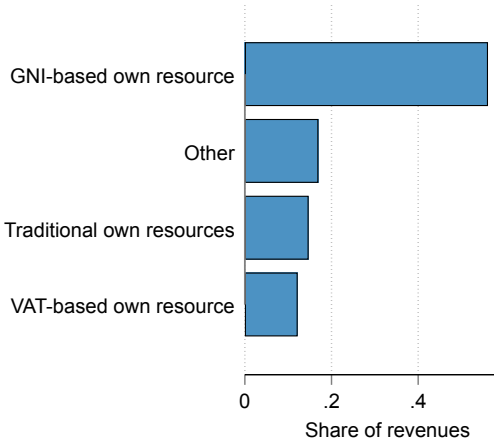
Krugman Specialization Index (value added).



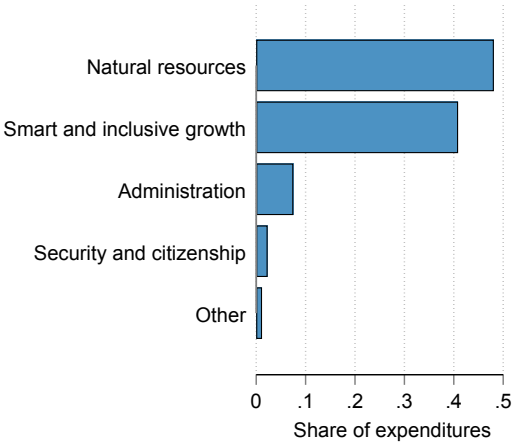
Import penetration ratio (manufacturing).

EU budget: revenues and expenditures

Long-term: Multi-annual Financial Framework (MFF) (e.g. 2014-2020).
Yearly: must be balanced (TFEU Art 310).

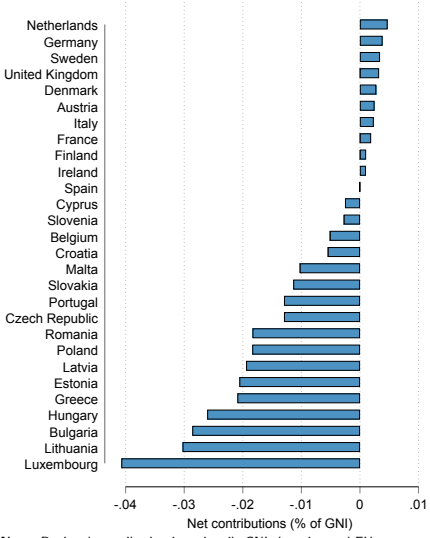


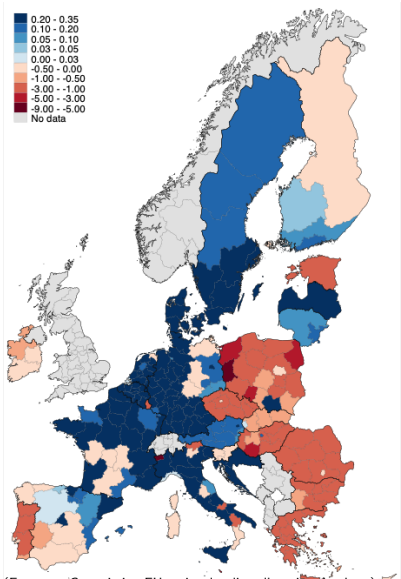
Revenues (2017) 139 billion euro.



Expenditures (2017) 137 billion euro.

EU budget: net contributors and net recipients





Note: Regional contribution is region i's GNI share in total EU payments minus regional receipts (European Commission EU regional policy allocation database).

Agenda

Environment

General equilibrium model of production, consumption and trade

- Multiple regions $\{i, j\}$ and sectors $\{r, s\}$.
- Production and consumption with input-output linkages within and across regions.

Households

- Preferences: love for variety across both regions and goods.
- Consumption: private and public goods.
- Income: from labor, capital, and international rents.

Production

- Firms source inputs from sector-regions to minimize costs.
- Pricing: monopolistic competition with external economies of scale.

Policies, taxes, subsidies, and budgets

Local governments

- Raise local taxes and provide production subsidies.
- Set public policy and local industrial policy.
- Can run budget deficits/surpluses.

Supra-national government

- Collects tariff revenues and local contributions; provides subsidies to regions.
- Sets common trade policy.
- Runs a balanced budget.

Preferences

Households in region j maximize

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

with $C_j = \prod_{s=1}^{S} \left(Q_j^s\right)^{\alpha_j^s}$, where Q_j^s is an aggregator for sector s goods in region j:

$$\underbrace{Q_j^s = \left(\sum_{i=1}^{N} (Q_{ij}^s)^{\frac{\sigma^s - 1}{\sigma^s}} \right)^{\frac{\sigma^s}{\sigma^s - 1}}}_{\text{across regions}} \qquad \underbrace{Q_{ij}^s = \left[\int_{\omega} q_{ij}^s(\omega)^{\frac{\theta^s - 1}{\theta^s}} d\omega \right]^{\frac{\theta^s}{\theta^s - 1}}}_{\text{across varieties}}$$

Demand for variety ω in region j for sector s goods produced in region i is:

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

E.g. demand for cars across countries (Fra/Ger) and brands (Peugeot/Renault/BMW/Audi).

Income

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 (idem, think of immobile capital).
- Net foreign capital owned by HH at home.

Gross National Income in region j

$$I_j = \underbrace{w_j L_j + r_j K_j}_{\text{value added}} + \underbrace{\sum_i \chi_{ij} r_i K_i}_{\substack{\text{share of foreign rents} \\ \text{owned at home}}} - \underbrace{\sum_i \chi_{ji} r_j K_j}_{\substack{\text{share of domestic rents} \\ \text{owned abroad}}} - T_j^{LOC} - \phi_j T^{EU}$$

where $\chi_{ij} = \frac{D_{ij}}{r_i K_i}$, D_{ij} is the bilateral trade deficit, and ϕ_j is region j's GNI share in the EU.

Production

Production: Sector s in region i produces a continuum of varieties ω with CRS technology

$$q_i^s(\omega) = \left[Z_i^s l_i^s(\omega)\right]^{\gamma_i^s} \left[k_i^s(\omega)\right]^{\delta_i^s} \prod_{r=1}^{S} \left[(Q_i^r)^{\rho_i^{rs}}\right]^{\beta_i^s}$$

where Q_i^r is a CES composite bundle of intermediates.

Costs and prices

$$c_i^s(\omega) = \Upsilon_i^s w_i^{\gamma_i^s} r_i^{\delta_i^s} \prod_{r=1}^{S} \left(P_i^r\right)^{\rho_i^{rs}\beta_i^s}$$

$$p_{ij}^s(\omega) = \frac{\theta^s}{\theta^s - 1} \frac{c_i^s \tau_i^s \kappa_{ij}^s}{{Z_i^s}^{\gamma_i^s}}$$

where τ_i^s is a net tax wedge ($\tau_i^s = 1 + \tilde{\tau}_i^s$)
and $\kappa_{ij}^s = (1 + t_{ij}^s) d_{ij}^s$ is a trade cost parameter, with *ad valorem* tariffs t_{ij}^s and iceberg costs d_{ij}^s.

External economies of scale

Sector prices for goods s from i to j

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

where M_i^s is the endogenous mass of firms in sector s in region i.

Sector-level economies of scale are

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

where μ^s is the markup rate ($1 + \mu^s = \frac{\theta^s}{\theta^s - 1}$).

The mass of firms is pinned down by a free entry condition

$$\underbrace{c_i^s \tau_i^s f^s}_{\text{entry costs}} = \frac{1}{\theta^s} \underbrace{\frac{Y_i^s}{M_i^s}}_{\text{output per firm}}$$

where f^s is a fixed cost of entry and Y_i^s is total sector output.

Local governments in each region i

Raise ad valorem taxes T_i^s and provide subsidies S_i^s on production to sector s.
Total net tax revenues are

$$\bar{T}_i = \sum_{s=1}^{S} (T_i^s - S_i^s) = \sum_{s=1}^{S} c_i^s \tilde{\tau}_i^s$$

Provide public goods G_i^s.
Total public goods consumption by the government is $\sum_s P_i^s G_i^s = G_i$.

Can run unbalanced budgets
Its budget constraint is given by $G_i = \bar{T}_i + \phi_i T^{EU} + B_i$, where B_i is the local budget deficit.

The supranational government

Collects taxes from regions as GNI contributions $T^{EU} = \sum_{i \in EU} \phi_i T^{EU}$.

Sets common trade policy and collects tariff revenues R_i.

Taxes and redistributes money to local governments running imbalances B_i.

Runs a balanced budget

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

A region can be **net recipient or net contributor** of supranational funds:

$$\phi_i T^{EU} - B_i \gtrless 0$$

Trade and gravity

Value of trade flows from region i to j in goods from sector s are:

$$X_{ij}^s = \left(\frac{1}{\theta^s}\right)^{-\frac{1-\sigma^s}{\theta^s-1}} \left(\frac{\theta^s}{\theta^s-1}\right)^{1-\sigma^s} (\kappa_{ij}^s)^{1-\sigma^s} (Z_i^s)^{\gamma_i^s(\sigma^s-1)} \left(\frac{Y_i^s}{(c_i^s\tau_i^s)^{\theta^s} f^s}\right)^{-\frac{1-\sigma^s}{\theta^s-1}} X_j^s (P_j^s)^{\sigma^s-1}$$

Expenditure shares are:

$$\lambda_{ij}^s = \frac{X_{ij}^s}{X_j^s} = \frac{(\kappa_{ij}^s)^{1-\sigma^s} (Z_i^s)^{\gamma_i^s(\sigma^s-1)} \left(\frac{Y_i^s}{(c_i^s\tau_i^s)^{\theta^s} f^s}\right)^{-\frac{1-\sigma^s}{\theta^s-1}}}{\left[\sum_{i=1}^N (\kappa_{ij}^s)^{1-\sigma^s} (Z_i^s)^{\gamma_i^s(\sigma^s-1)} \left(\frac{Y_i^s}{(c_i^s\tau_i^s)^{\theta^s} f^s}\right)^{-\frac{1-\sigma^s}{\theta^s-1}}\right]}$$

Market clearing and trade balance

Goods market clearing: Sector s production in i equals world expenditures on s from i

$$Y_i^s = \sum_{j=1}^{N} X_{ij}^s = \underbrace{\sum_{j=1}^{N}\sum_{r=1}^{S} \frac{\lambda_{ij}^s}{1+t_{ij}^s}\beta_j^r \rho_j^{sr} Y_j^r}_{\text{intermediate sales}} + \underbrace{\sum_{j=1}^{N} \frac{\lambda_{ij}^s}{1+t_{ij}^s}\alpha_j^s I_j}_{\text{final demand HH}} + \underbrace{P_i^s G_i^s}_{\text{final demand gov't}}$$

Trade balance D_i is endogenous:

$$D_i = \underbrace{\sum_{j=1}^{N}\sum_{s=1}^{S}\sum_{r=1}^{S} \frac{\lambda_{ji}^s}{1+t_{ji}^s}\beta_i^r \rho_i^{sr} Y_i^r}_{\text{imports of intermediate goods}} + \underbrace{\sum_{j=1}^{N}\sum_{s=1}^{S} \frac{\lambda_{ji}^s}{1+t_{ji}^s}\alpha_i^s I_i}_{\text{imports of final goods}} - \underbrace{\sum_{j=1}^{N}\sum_{s=1}^{S}\sum_{r=1}^{S} \frac{\lambda_{ij}^s}{1+t_{ij}^s}\beta_j^r \rho_j^{sr} Y_j^r}_{\text{exports of intermediate goods}} - \underbrace{\sum_{j=1}^{N}\sum_{s=1}^{S} \frac{\lambda_{ij}^s}{1+t_{ij}^s}\alpha_j^s I_j}_{\text{exports of final goods}}$$

Consumption and income

$$\underbrace{\sum_{j=1}^{N}\sum_{s=1}^{S} \frac{\lambda_{ji}^s}{1+\tau_{ji}^s}\alpha_i^s I_i}_{\text{imports of final goods}} = \underbrace{w_i L_i + r_i K_i - T_j^{EU} - T_j^{LOC} + D_i}_{\text{income}}$$

where D_i is fully financed by the net foreign returns.

Some intuition on equilibrium behavior

Tax revenues T^{EU} adjust to a policy shock to ensure balanced EU budget.

Example 1: Increase in public goods consumption G_i^s

- Paid by an increase in local taxes.
- Direct: Increases demand for sector s output in region i.
- Indirect: Increases demand of (in)direct suppliers to s in i (Leontief inverse).
- Higher demand triggers firm entry.
- Increases imports and tariff revenues, lowering optimal T^{EU} in equilibrium.

Example 2: Increase in production subsidies τ_i^s

- Paid by an increase in local taxes.
- Lowers the cost of production and thus prices.
- Makes local producers relatively more competitive and boosts exports.
- Lower costs trigger firm entry.
- Induces trade diversion away from imports towards regional inputs.
- Decreases imports and tariff revenues, raising optimal T^{EU} in equilibrium.

In both cases, the net effects depend on the full structure of the model.

Equilibrium responses to policy shocks

Firms costs

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

Input prices

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

Import shares

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

Total gross output

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

Agenda

Welfare effects: contribution of channels

Change in welfare for region j is given by:

$$\hat{W}_j = \left(\hat{G}_j\right)^{\eta_j} \left(\frac{\hat{I}_j}{\hat{P}_j}\right)^{1-\eta_j}$$

How does a policy affect welfare? Log-linearize e.g. prices:

$$d \log P_j = \sum_{s=1}^{S} \alpha_j^s d \log P_j^s$$

$$d \log P_j^s = \underbrace{\frac{d \log \lambda_{jj}^s}{\sigma^s - 1} + \left(d \log c_j^s \tau_j^s\right)}_{\text{ACR}} - \underbrace{\gamma_j^s d \log Z_j^s}_{\text{productivity}} + \underbrace{\mu^s \left[d \log \left(c_j^s \tau_j^s\right) - d \log Y_j^s\right]}_{\text{external economies of scale}}$$

Welfare effects: Entry of policies into the model

$$d \log P_j^s = \underbrace{\frac{d \log \lambda_{jj}^s}{\sigma^s - 1} + (d \log c_j^s \tau_j^s)}_{\text{ACR}} - \underbrace{\gamma_j^s d \log Z_j^s}_{\text{productivity}} + \underbrace{\mu^s \left[d \log (c_j^s \tau_j^s) - d \log Y_j^s \right]}_{\text{external economies of scale}}$$

Direct effects

Trade policy: κ_{ij}^s (inside λ_{ij}^s). Industrial policy: τ_j^s or Z_j^s. Public policy: Y_j^s.

Welfare effects: external economies of scale

$$d \log P_j^s = \underbrace{\underbrace{\frac{d \log \lambda_{jj}^s}{\sigma^s - 1} + d \log(c_j^s \tau_j^s)}_{\text{ACR}} - \underbrace{\gamma_j^s d \log Z_j^s}_{\text{productivity}}}_{\text{intensive margin}} + \underbrace{\underbrace{\mu^s}_{\text{external economies of scale}} \left[d \log (c_j^s \tau_j^s) - d \log Y_j^s \right]}_{\text{extensive margin}}$$

Economies of scale

- If $\mu^s = 0$, there are no EES. All effects are on the firm intensive margin.
- If $\mu^s > 0$, increase in demand or decrease in costs triggers firm entry, lowering prices.

Welfare effects: input-output linkages

The role of input-output linkages on demand. Log-linearizing and totally differentiating the goods market clearing condition, we can write

$$\mathbf{d}\log\mathbf{Y} = \mathbf{\Psi} d\log\mathbf{F}$$

where $\mathbf{\Psi} = \left(\mathbf{I} - \mathbf{B}^T\right)^{-1}$ is the *revenue-based* Leontief inverse for allocation matrix $\mathbf{B}$.
Elements ψ_{ji}^{sr}: total effect of a change in final demand from r in i on output of sector s in j.

The role of input-output linkages on costs. Log-linearizing and differentiating the cost function:

$$d\log\mathbf{c} = \tilde{\mathbf{\Psi}} d\log\mathbf{V}$$

where $\tilde{\Psi} = \left(\mathbf{I} - \tilde{\mathbf{A}}\right)^{-1}$ is the *cost-based* Leontief matrix with $\tilde{\mathbf{A}}$ the matrix of technical coefficients ajusted for markups. $\mathbf{V}$ is a vector of value added.
Elements $\tilde{\psi}_j^{rs}$: change in input costs of sector s in region j from a change in sector r prices.

Welfare effects: input-output linkages

Plugging the multipliers back into the pricing equation:

$$d \log P_j^s = \underbrace{\frac{d \log \lambda_{jj}^s}{\sigma^s - 1} + \sum_{r=1}^{S} \tilde{\psi}_j^{rs} d \log V_j^r}_{\text{ACR}} - \underbrace{\gamma_j^s d \log Z_j^s}_{\text{productivity}} + \underbrace{+ \mu^s \left[\sum_{r=1}^{S} \tilde{\psi}_j^{rs} d \log V_j^r + d \log \tau_j^s - \sum_{i=1}^{N} \sum_{r=1}^{S} \psi_{ji}^{sr} d \log F_i^r \right]}_{\text{external economies of scale}}$$

Input-output multipliers: Prices of sector s in j

- High ψ_{ji}^{sr}: r is an important customer of $s \rightarrow \Delta$FD triggers firm entry and lowers prices.
- High $\tilde{\psi}_j^{rs}$: r is an important supplier to $s \rightarrow \Delta$VA contributes more to price change in s.

Agenda

Data sources

Regional production, value added, consumption, value chains, net taxes

- MRIO data for RHOMOLO model (JRC at the European Commission).
- Regions: 235 EU regions, 18 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).
- Used to calculate initial values for B_i.

Model objects and data

Model object	Data
X_{ij}^{sr}	Intermediate goods matrix
Y_i^s	Gross output
$w_i L_i$	Value added: compensation of employees
$r_i K_i$	Value added: gross operating surplus
$\bar{T}_i^s$	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 s, $\sum_i X_{ij}^{sr} / \sum_i \sum_s X_{ij}^{sr}$
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	$w_j L_j^r / Y_j^r$
δ_j^r	$1 - \gamma_j^r - \beta_j^r$
$\tilde{\tau}_j^r$	Net tax wedge, $\frac{\bar{T}_j^s}{\sum_i \sum_s X_{ij}^{sr} + w_j L_j + r_j K_j}$
μ^s	Scale elasticity, 0.09
σ^s	Trade elasticity, 5

Policy exercises

Exercise 1 – Trade policy

- 10% increase in (iceberg) trade costs for all manufacturing imports κ_{ij}^{s}.
- Raised by the supra-national government.

Exercise 2 – Industrial policy

- 10% increase to production subsidies in all manufacturing sectors τ_{i}^{s}.
- Provided by each local government to its own sectors.

Exercise 3 – Public policy

- 10% increase in final demand for manufacturing sectors G_{i}^{s}.
- Provided by each local government to its own sectors.

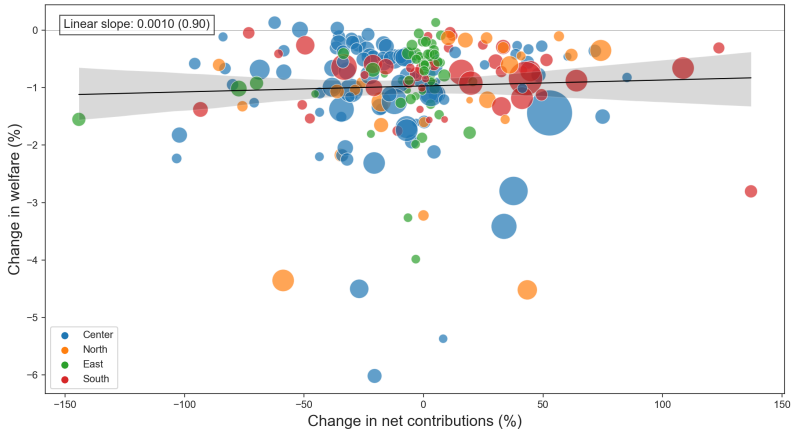
Aggregate welfare effects

EU $\hat{W}(\%)$	ACR	ACR + EES	Full	Stdev(Full)
Trade policy	-0.16	-0.11	-0.27	0.49
Industrial policy	0.00	0.01	0.03	0.15
Public policy	-0.03	-0.03	0.01	0.08

Notes: EU aggregate welfare effects from GNI shares of regions: $\hat{W} = \sum_j \phi_j \hat{W}_j$.
Stdev is the standard deviation across regional outcomes.

Regional heterogeneity: trade policy

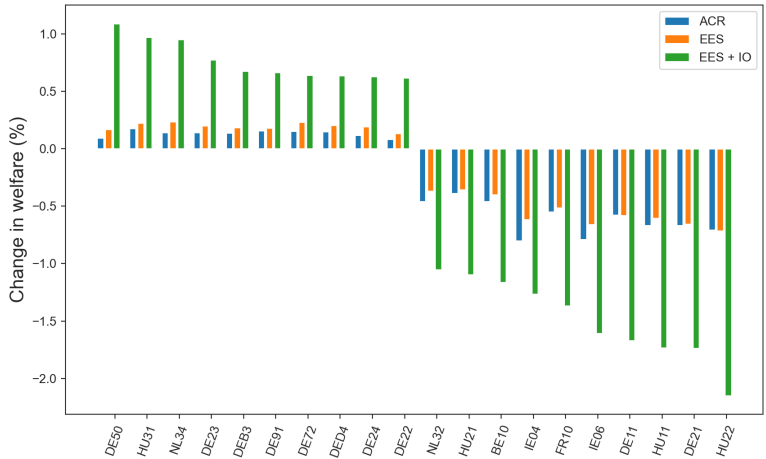
- Intuition: Imports drop. Reallocation to intra-EU suppliers, but at higher prices.
- Welfare: Almost every region loses. Large variation in Center, less for South.
- Budget: There can be large shifts in contributions, but uncorrelated with welfare changes.



Regional heterogeneity: trade policy

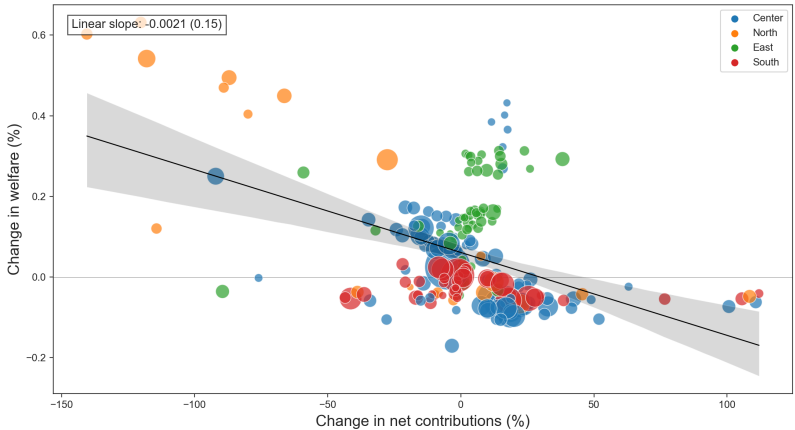
Massive heterogeneity in outcomes across regions

- Input-output linkages contribute most to welfare changes.
- Even within countries (e.g. DE, NL, HU) some regions are top winners, others top losers.



Regional heterogeneity: industrial policy

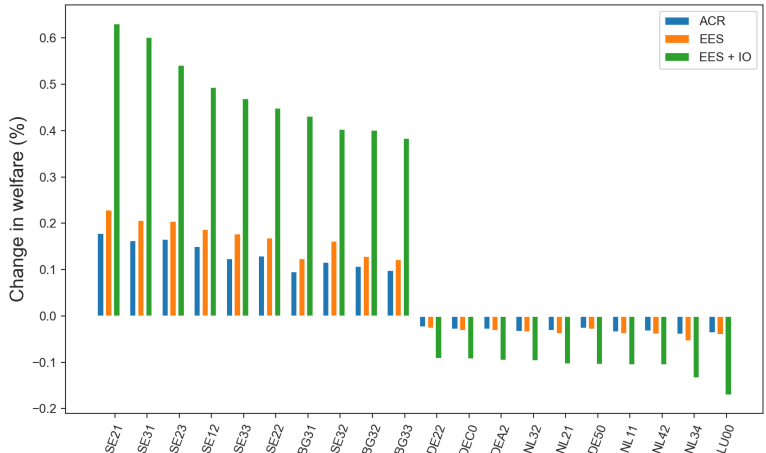
- Intuition: Lower costs. Reallocation of sourcing to intra-EU, at lower prices.
- Welfare: winners and losers, largest gains for North, largest losses for South.
- Budget: North regions gain most and reduce budget contributions most.



Regional heterogeneity: industrial policy

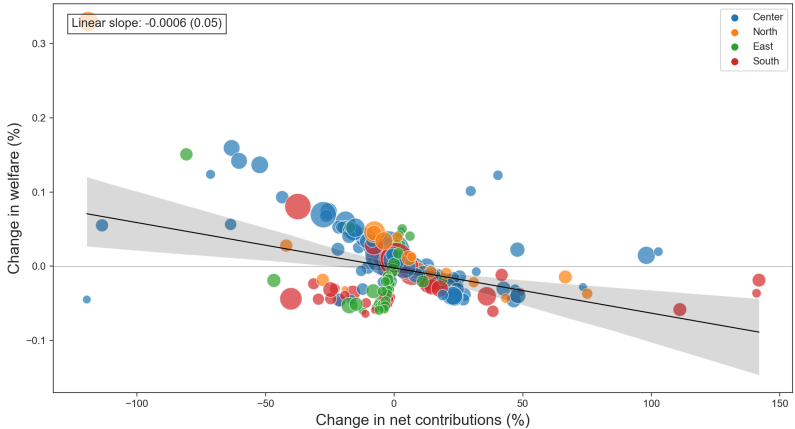
Massive heterogeneity in outcomes across regions

- Input-output linkages contribute most to welfare changes.
- Losers lose less than winners gain.



Regional heterogeneity: public policy

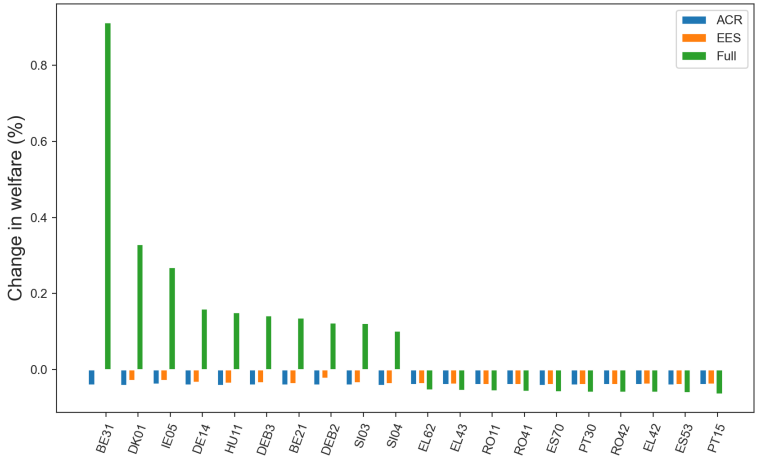
- Intuition: Govt spending increases demand at a cost of higher taxes.
- Welfare: winners and losers. Largest variance for Center.
- Budget impact: East has lowest variance in budget outcomes.



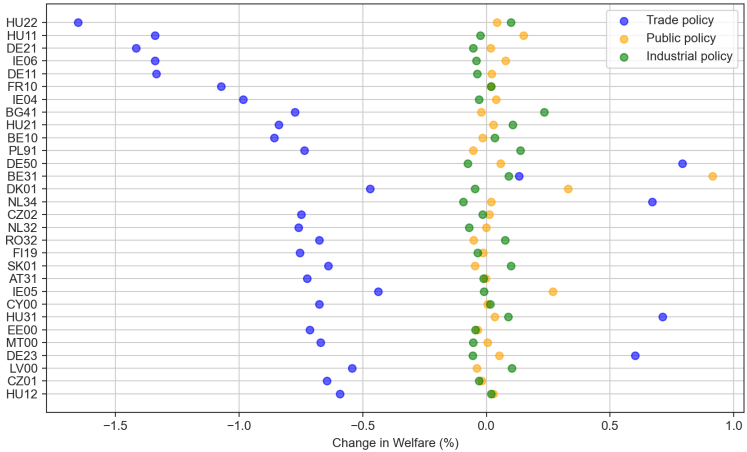
Regional heterogeneity: public policy

Massive heterogeneity in outcomes across regions

- Input-output linkages contribute most to welfare changes (some with opposite effects).
- Losses are smaller and less dispersed.



Regions can win under one policy and lose in another



Conclusion

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

- Trade model with EES, IO linkages, and multi-layer governments.
- Input-output linkages contribute most to welfare changes.
- Each policy has a different impact on both aggregate welfare and regional heterogeneity.
- Even if aggregate effects are small, there is massive variation across regions.

Which policies for which sector-regions at which level?

- Subsidiarity and proportionality principles vs. subsidy shopping.
- Role for the EU government to coordinate scale economies?